The FOUNDRY

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Castings Add Artistic Touch To Railway Stations

EACH decade witnesses a remarkable change in the style of passenger stations built by the railroads. The day of the old, wood frame depot with its dark waiting room, smoking stove and uncomfortable benches rapidly is passing, as the railroads continue their remarkable march of progress. While the comfort of the traveling public has been given first consideration, the designers in charge of the construction of new stations have gone a step further and have designed buildings noted for their architectural beauty. In this work and especially for interior decorations, castings of various types have played a prominent part. The next time you dash to the ticket window to purchase a ticket to New York, Oshkosh or Timbuctoo, take a minute to look at the ticket window. It is more than likely, if the station is one of the newer types, that the metal parts of the windows are built chiefly of castings. For example, in the new terminal station at Cleveland, which probably will be the first to welcome thousands of foundrymen to Cleveland for the American Foundrymen's Association convention in May, the ticket windows are constructed of bronze castings. Other institutions, such as banks, are using castings to secure artistic effects in connection with the windows where much of the business is transacted.

Castings Have Played an Important Part in the Beautification of Railroad Terminals

Find Where Castings Can Be Sold

CONTENTS

FEATURE ARTICLES

	Page
Gray Iron Possesses Valuable Engineering Properties	94
A. F. A. Plans Shop Operation Courses	98
Copper Oxide Eliminates Aluminum—By J. H. Cheetham	99
Compares Methods of Producing Electric Steel—By George Batty	100
Large Aluminum Casting Taxes Foundry Ingenuity—By Herbert Simonds	103
Fundamentals of Foundry Practice—Part III—By Ivan Lamoureux	105
Unify Gray Iron Costs	109
Locomotive Cylinders Have Changed—By Robert E. Masters	111
Art Bronze Is Cast in Chicago Foundry	112
Uniform Methods of Analysis Should Govern Core Oil Specifications—By V. A. Crosby and R. D. Wysong	121
Bill Discusses Number of Foremen Required—By Pat Dwyer	123
Long Beds Warp in the Mold—By R. H. Palmer	126
Will Foster Industrial Research—By H. W. Gillett	129

REGULAR DEPARTMENTS

Questions and Answers on Foundry Practice	115	**Foundry Association Directory**	132
Problems in Nonferrous Founding — By Charles Vickers	118	**Trade Trends in Tabloid**	133
The Shakeout	130	**What the Foundries Are Doing**	136
Comings and Goings of Foundrymen	131	**New Trade Publications**	136

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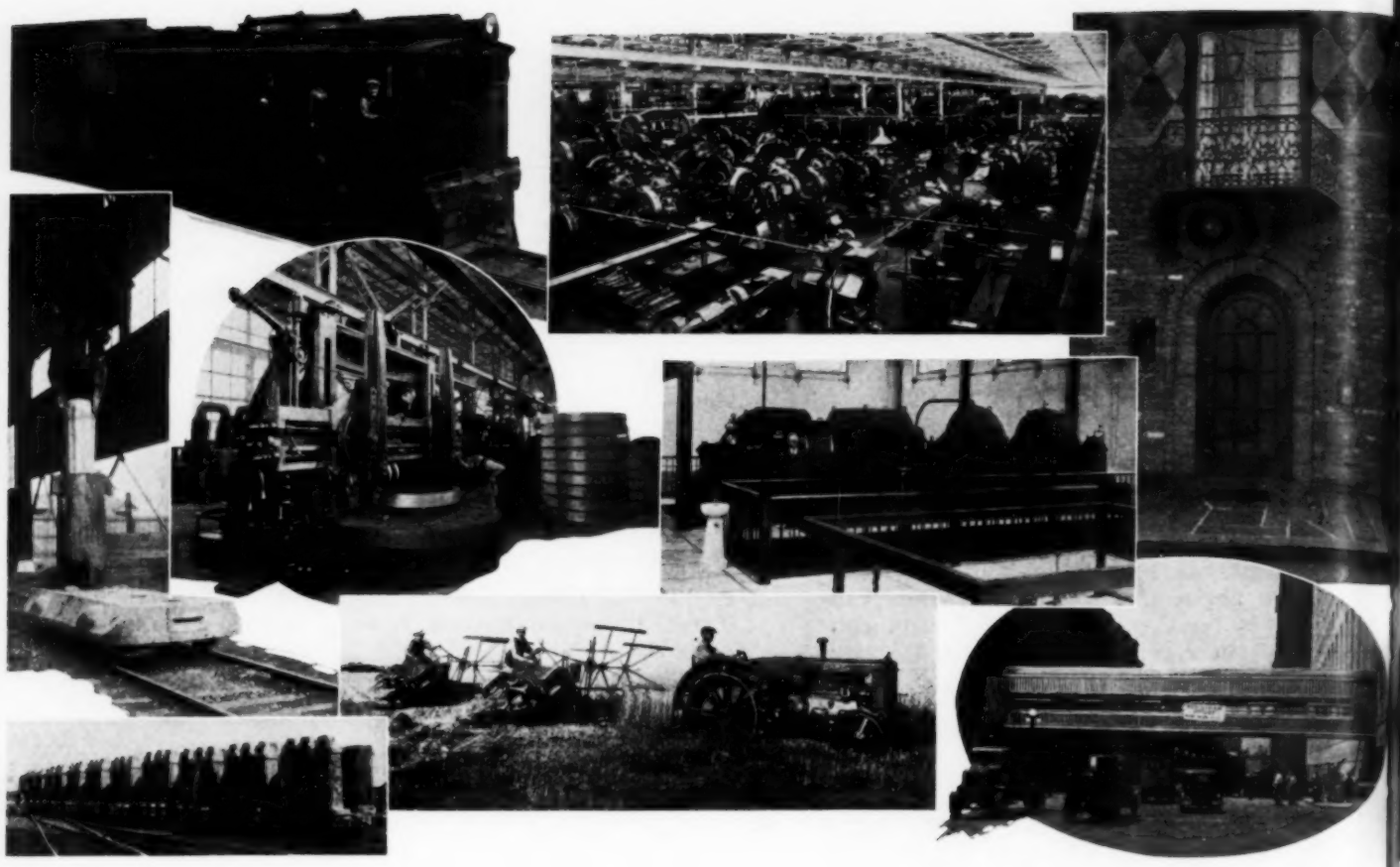
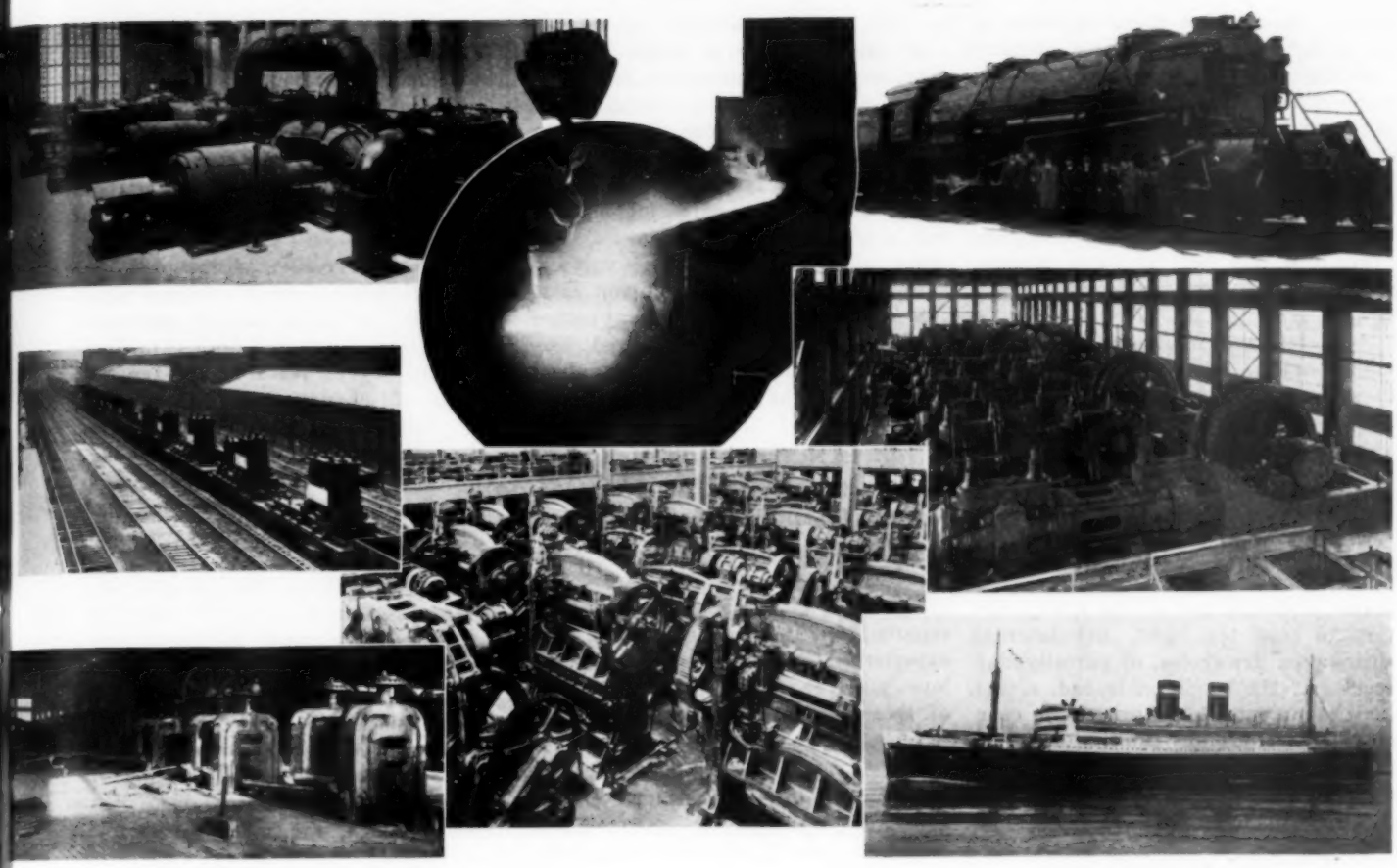


GRAY Possesses Valuable

MANY considerations are involved in the selection and application of materials of construction. In general the best material is that which fully satisfies service equipment at the least overall cost. However, service requirements rarely are defined clearly or understood fully. Furthermore, actual performance over a number of years is the only exact criterion; experience furnishes the true measuring stick. Overall cost is not determined in a brief period. In discussing the suitability of materials no hard and fast rules can be laid down. Each application deserves individual consideration and judgment. Applications of gray iron castings can be classed as artistic and utilitarian as shown in the accompanying illustration. The fluidity of molten cast iron and its expansion after solidification due to graphitization allow it to be cast easily into intricate shapes with excellent delineation of detail. Thus it is well adapted indeed to certain types of art castings. However, most of its applications are utilitarian, as it is a truly economical material for many applications in engineering design. Also, it must not be forgotten that in most cases designs are made for certain materials rather than materials adapted to design. Every design is to some degree a compromise, as the engineer is limited by the properties of the materials as well as by cost and other factors. Speaking broadly, uses of metals are mechanical or chemical or both. In addition to considerations of stresses, vibration, wear, corrosion and the like, the designer faces certain limitations in space, weight, necessity for symmetry, etc., as well as the ever present problem of economy. Gray iron castings have been used for many years and extensive ex-

Will Give Facts

FOR some time progressive foundrymen have known that considerable progress has been made in the development of high quality gray cast irons for engineering purposes. Unfortunately, they have neglected to inform engineers of the many valuable properties of gray iron. This undoubtedly is due to the fact that engineers desire definite data which the foundrymen have been unable to supply. It requires considerable time to check and compare the available literature to obtain the essential features. To meet this need, THE FOUNDRY has arranged this series of articles to supply both foundrymen and engineers with authoritative data on the engineering properties of cast iron. This is the first article. The second will appear in an early issue.



IRON Engineering Properties

perience has been obtained on their performance in service. Unfortunately, the term gray iron is applied rather loosely to a series of alloys of iron, carbon, and silicon; alloys that vary widely in their properties from one part of the series to another. Most foundrymen have not realized this. However, the iron foundry industry recently has realized the importance of furnishing proper grades of iron. Prior to the World war enough information was available in the technical press to enable many foundrymen to improve their practice, yet the research and investigations of the past ten years evince more progress in this period than during the 25 years previous. While a few foundrymen have taken full advantage of increases in the technical information, the engineering fraternity has not been informed of much of the progress which has been made. Most of the information on gray iron castings in the standard engineering handbooks and reference works dates back to the nineteenth century.

Gray iron castings in the great majority of places have given excellent service over many years. In other instances some failures have been recorded. Few investigations have been made to establish the reasons for the variance in results. That these differences might be traceable to use of different grades of materials did not occur to many people. As a natural result, many engineers feel that gray iron is a rather unreliable material, and they will continue to think this way until foundrymen show them otherwise. It is plain, hard facts, not rosy propaganda, that impress the engineer. Two pre-eminent virtues of gray iron castings are the usual soundness and low cost. Soundness is a prime requisite in any engineering ma-

Has Wide Use

THE wide spread and varying application of gray iron is portrayed excellently in the accompanying illustrations at the top of these pages. The weight of individual castings may range from a fraction of an ounce as in the case of parts of cast toys to 125 tons in the case of engine beds, ingot molds, anvil blocks, etc. One unusual sized anvil block cast in Russia weighed 600 tons. Application of gray iron ranges from the artistic as depicted in the ornamental balcony shown, to the strictly utilitarian represented by the locomotive, machinery, automotive, power plant, steel mill, steamship, and agricultural scenes displayed. While these are only a few of the uses of cast iron, many others will come to mind readily.

terial. In castings there is little or no chance to get improved soundness once the piece is cast. Gray iron has good fluidity and its contraction is only about one-half that of other cast metals such as steel and malleable iron. The metal itself does not absorb gases readily. The fact that sound castings are obtained easily in gray iron has led to some abuses, both in design and in foundry practice.

All castings, whether in iron or other metals, should be as uniform in section as possible. Unequal sections cause different cooling rates within parts of the same casting. Thus part of the casting still may be liquid, or at least plastic while an adjoining section may be solid and contracting more rapidly. Metal is drawn out of the heavy section to feed the light, and internal shrinkages, drawholes, or porosity may result. If the condition is bad, actual cavities may be found within or even on the surface of the casting. If the condition is not so bad there generally is some internal porosity and consequently a greatly weakened area.

Alteration in Design Helps

This latter condition too often is overlooked. The foundryman may be able to help some by care in determining the location of gates and risers and feeding liquid metal into the heavier section. Unless the need for the disproportionate sections is real, the fundamental cause is best removed by alteration in design. An English metallurgist of long practical experience once remarked that more castings are lost on the drawing board than in the foundry. While the general outlook is not so pessimistic, the designer certainly has some responsibility in assisting to obtain good sound castings. One illustration will suffice.

Housings on a certain boring mill did not seem rigid enough. The faces were about 2½-inch sections. The housings were redesigned and ¾-inch webs with insufficient fillets were placed in the core just back of the face. On machining the faces, spongy areas were noted. These are explained easily enough by the contiguous location of heavy and light metal sections. Furthermore, rigidity was not what was expected. Another trouble with thick and thin sections, and with light supporting sections improperly placed is the danger of excessive internal stresses. A thin section will contract more than a heavier. In gray iron this is due mostly to the usually greater degree of graphitization which takes place in the heavier sections of metal.

In another case a large housing used in a large automotive truck engine assembly gave considerable trouble. About 20 per cent of the castings were cracked during delivery from foundry to machine shop and more were cracked during machining and assembly. The metal was questioned, the core practice was examined, and the handling given careful scrutiny. No solution appeared until the castings were sawed partially open. They sprung apart about 3/16-inch at the saw cut. A couple of ribs supposed to add strength, were removed and no further trouble was experienced. Incidentally use of alloys may be advantageous in some of these places when the design cannot be changed.

¶Gray iron is not one metal, it is a series of alloys of widest varying physical properties and the necessity for selection of proper grades is obvious.

Logical design minimizes the tendency toward internal unsoundness and excessive internal stresses. These tendencies are more pronounced in the stronger type irons. These as a rule demand more provision for feeding than other grades. As an engineering material gray iron has a number of unique and valuable characteristics. These include the ease with which it can be cast into intricate shapes and light sections, and its extreme soundness in castings, providing even reasonable care is taken in molding and pouring practice. Gray iron has comparatively low shrinkage, minimizing necessity of elaborate systems of gates and risers to avoid porous areas. A good, smooth finish can be obtained and the castings are clean, free from dross, pinholes and like defects.

Gray iron possesses a marked uniformity when properly made and readily may be cast to close dimensional tolerances. It has good machining properties and supplies low cost castings due to a combination of inexpensive raw materials, highly efficient melting process, easy casting properties not requiring elaborate precautions in molding practice, little waste in risers, low cleaning cost, and usually low losses. Tensile strength of the usual commercial grades of gray iron is from 20,000 to 40,000 pounds per square inch. Special grades with strength up to 60,000 pounds per square inch are obtainable.

It has high compressive strength which often is about four times the tensile strength, and a high modulus of rupture ranging up to 90,000 pounds per square inch is obtained in transverse loading, due to the shifting of the neutral axis, and high compressive strength. Gray iron possesses a high brinell hardness compared to its machinability. Exceptional wear resisting properties are notable as is the practical freedom from tendency to gall or seize, even at elevated temperatures. It has a definite and proportionately rather high *fatigue* strength. Other features are the retention of strength up to somewhat over 800 degrees Fahr. on short time tests, its low specific gravity ranging from 6.9 to 7.2 which is lower than other regular ferrous metals, the brasses, tin bronzes, and nickel alloys, and its good resistance to many types of corrosion (caustic, concentrated sulphuric acid, etc.)

Before proceeding to discuss undesirable properties it may be stated that many troubles attributed to gray iron have been due to selection of improper grades for services intended. With proper information at his disposal the designer will avoid misapplications. Gray iron is not one metal, it is a series of alloys of widely varying physical properties and necessity for selection of proper grades is obvious. Furthermore, shop production executives sometimes insist on poorer, softer grades to get unduly high machine tool performance.

Ductility Not Needed

Among the less desirable properties of gray iron are its comparatively low Young's modulus of elasticity which ranges usually between 12,000,000 and 15,000,000 at 50 per cent ultimate load value. The Young's or tensile modulus of elasticity for all types of steel is close to 30,000,000. The alleged great rigidity of gray iron is mythical as it rarely possesses over half the rigidity of steel. Cast iron has a negligible ductility. This prevents fabrications by either cold or hot working. A piece of cast iron will break before distortion, whereas steel will give some warning by distortion before fracture. However, great ductility is a virtue of negligible value in most machine design. It is necessary where there is danger to life, as in certain pressure containing parts containing hot liquids or highly compressed gases.

In the absence of accurate data on impact value, gray iron has received more condemnation than it deserves. The improper and literally spongy

materials sometimes used will not stand much shock. Some of the better grade irons have 15 times the shock resistance of inferior grades. A good tough iron will stand an amazing amount of abuse before fracture. Due to the low shock resistance of improper grades of iron, many designs have been changed to other metals, whereas the proper grade of iron would have proved satisfactory and far more economical.

Gray iron has been condemned for the open grain or pitted appearance on machined surfaces. There is no excuse for this, and its appearance is a certain indication that an inferior grade of metal is employed, either through ignorance or desire for too ready machinability. Experiments have shown that the character of cut influences this appearance. It is worst when heavy roughing-out is used and minimized by fine finishing cuts. An exceedingly open-grained piece can be made to appear perfectly smooth by a heavy grind which exerts a peening action. Obviously, this does not better the actual properties of the metal.

Can Eliminate Hard Spots

Occasional appearance of hard chilled spots has led to many complaints. In extreme light castings it requires careful adjustment of mixture or use of alloys such as nickel to avoid this trouble. In heavier castings there is no excuse for chilled spots if logical metallurgical procedure is adhered to. Many old time foundrymen attempt to adjust the properties of their castings by control of percentage of silicon only, paying little or no attention to that important element, carbon. As a result they usually get a much more brittle and less machinable metal than is desirable. Their metal may pass the requirements for physical strength, but a material lower in carbon and higher in silicon would serve the designers purpose much better and be more economical.

Growth of cast iron is a bugbear which has worried designers for many years. Under even moderate heat, particularly in presence of steam and of certain mildly corrosive fluids, some structures have been observed to grow or expand markedly. This growth is accompanied by softening and weakening of the metal. No strength is left and the material practically falls apart. Occasional appearance of this phenomenon has caused leading engineering societies to limit the applications of cast iron to 450 degrees Fahr. when employed in pressure containing parts. This trouble often is due to the use of improper grades as will be explained in later instalments of this series.

The ease with which gray iron can be cast into intricate shapes is noteworthy. Automotive cylinder blocks often are complicated and have light sections, particularly around the water jackets, yet thousands of these are cast every day and losses are low. Piston rings present another example. Art castings requiring delineation of minute detail are made of gray iron, and one does not have to look far to find really beautiful examples. Low melting point, good fluidity and low shrinkage (contraction) make gray iron an excellent material insofar as casting properties are concerned. Too, these properties make gray iron castings economical to mold, promote sound castings free from shrinkage defects, and permit excellent finish (casting skin) to be obtained without any great difficulty.

¶It is not necessary to look far to find many really beautiful examples of art castings which are made of gray iron and require delineation of minute detail.

When design is logical and foundry practice good, gray iron castings are excelled by none in uniformity and soundness. Gray iron does not warp or crack in the sand as readily as some other metals. Its low contraction which is about ⅛-inch per foot makes it easy to cast to close dimensional standards. The degree of accuracy, of course, depends on the equipment available and the nature of the casting. First class pattern equipment, proper grades of molding sand, good molding practice, setting cores by jigs, and careful pouring practice are essential.

Automotive cylinder blocks and seamless dryer rolls for paper mill machinery are good examples respectively of fairly light and quite heavy castings which are cast to close tolerances by skilled manufacturers. At least one large agricultural implement manufacturer has eliminated a substantial portion of former machining operations by casting to close tolerances. Permanent mold castings can be made quite accurately. Long heavy castings, like long planer beds tend to sag or bow due to their great weight and length. Skilled foundrymen can lessen this tendency markedly.

Machining properties of gray iron include, good-metal removal rates which are several times faster than those usual in machining steel, and on the softer grades are near, if not equal to those of well annealed malleable. Gray iron does not drag or gum up the tools. As in all machining work rigid tools and fixtures plus proper preparation of good tool steels, stellite, etc., facilitate best results. The new tungsten carbide tools appear promising for certain applications.

Minimum tensile strength requirements of various grades of cast iron specified by various organizations include: High test gray iron, (American Society for Testing Materials, A-88-29 tentative) 33,000 pounds per square inch; grade A (British Engineering Standards association, specifications 321-1928), 24,640 pounds per square inch; higher strength iron for valve and fittings (A. S. T. M.—A-129 tentative) 30,000 pounds per square inch; regular gray iron (A. S. T. M. A-48-light) 18,000 pounds per square inch; regular gray iron (A. S. T. M. A-48-medium) 21,000 pounds per square inch; regular gray iron (A. S. T. M. A-48-heavy) 24,000 pounds per square inch, and grade C (British Engineering special 321) 20,160 pounds per square inch. These tests app y to the so-called arbitration bars 1.20-inch diameter. To insure compliance with these specifications careful manufacturers usually maintain an average strength 10 to 20 per cent above the figures mentioned in the specifications.

Book Review

The Practice of Spectrum Analysis, paper, 6¼ x 9¾ inches, 38 pages, published by Adam Hilger Ltd., London, England, and supplied by THE FOUNDRY, Cleveland, for 50 cents, plus 15 cents postage, and in England, by the Penton Publishing Co. Ltd., 416-17 Caxton House, Westminster, for 1s 6d.

This small volume is the fourth edition of this work compiled by F. Twyman and contributed to by E. N. Andrade, S. J. Lewis, D. M. Smith, S. Barratt, A. A. Fitch and J. W. Ryde who have done much to advance spectrographic analysis. Chapter I deals with types of problems to which spectrum analysis is applicable while Chapter II describes spectragraphs for spectrum analysis. Ways and means of exciting emission spectra are given in Chapter III, and Chapter IV relates to taking spectrograms, measuring wavelengths and identifying elements. Chapter V discusses quantitative spectrum analysis and Chapter VI deals with the various types of spectrum. An appendix gives data on the determination of wavelengths by interpolation.

A. F. A. Plans Shop Operating Courses

GREATER interest shown by an increasing attendance at the round-table meetings and shop-operation courses, which formed a part of the past few conventions of the American Foundrymen's association, has led the program committee to broaden the scope of these sessions for the 1930 annual meeting. The program for this year's convention, scheduled for the week of May 12 at Cleveland, provides for three round-table luncheon meetings covering malleable, steel and nonferrous foundry practice.

Chairmen selected to lead these meetings are well-known leaders in their respective branches of the industry. H. M. St. John, metallurgist, Detroit Lubricator Co., Detroit, will preside at the nonferrous meeting. W. J. Corbett, Fort Pitt Steel Castings Co., McKeesport, Pa., will lead the steel group, and P. C. DeBruyne, Moline Malleable Iron Co., St. Charles, Ill., will act as chairman for the malleable group round-table discussions.

No specially prepared papers will be presented at these informal luncheon meetings, but every one present will be given an opportunity to propose and to discuss any phase of management, metallurgy or shop practice he cares to bring up.

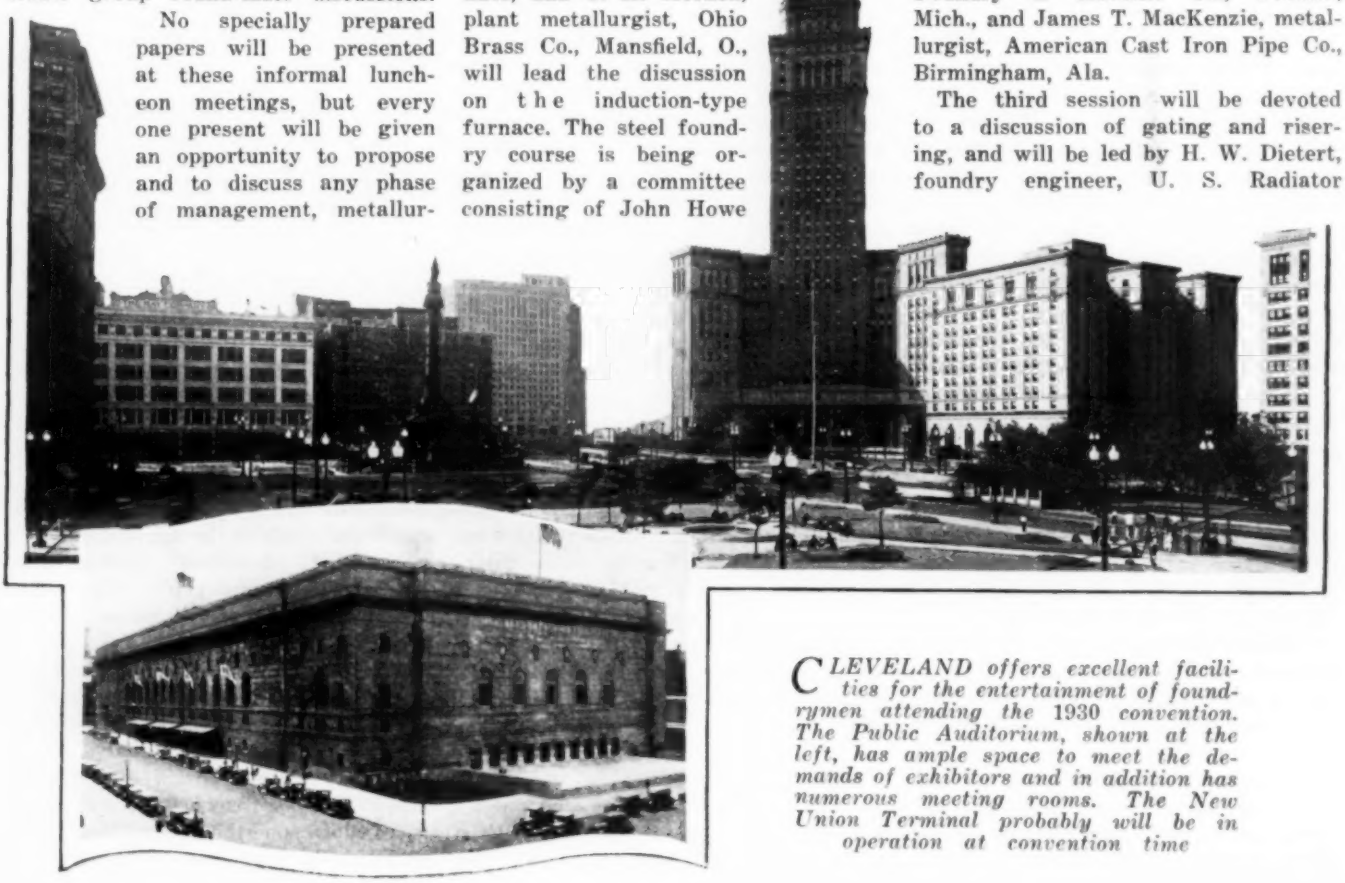
Three shop-operation courses, organized expressly for the practical shopman, are scheduled. These will cover steel foundry operation, gray-iron foundry operation and nonferrous foundry practice. Each course will consist of a series of three or four sessions, the leaders for each session being assigned a definite subject for discussion.

Thus, W. F. Graham of the technical division, Ohio Brass Co., Mansfield, O., is in charge of organizing the course for the nonferrous foundrymen. The subjects which will be discussed at this course include crucible, open-fire and electric furnace practice. D. E. Broggi, foundry superintendent and metallurgist, Neptune Meter Co., Long Island City, N. Y., will lead the discussion on the indirect-arc type furnace, and C. H. Morken, plant metallurgist, Ohio Brass Co., Mansfield, O., will lead the discussion on the induction-type furnace. The steel foundry course is being organized by a committee consisting of John Howe Hall, Taylor-Wharton Iron & Steel Co., High Bridge, N. J.; F. J. Stanley, works manager, Michigan Steel Castings Co., Detroit, and C. D. Carey, works manager, American Steel Foundries, Verona, Pa. Sessions outlined for the steel course will cover chipping, grinding and riser removal; heat treating and heat-treating equipment, and core practice—including anchoring, rodding, venting and sand mixtures.

Four sessions will comprise the gray iron shop-operation course. The first session wil cover cupola materials and will be under the direction of C. J. Scullin, Tucker-Scullin Inc., St. Louis. Mr. Scullin will be assisted by E. J. Lowry, consulting metallurgist, Detroit.

Cupola materials and operation will be discussed at the second session, under leadership of R. S. MacPherran, chief chemist, Allis-Chalmers Mfg. Co., Milwaukee. He will be assisted by F. J. Walls, metallurgist, Wilson Foundry & Machine Co., Pontiac, Mich., and James T. MacKenzie, metallurgist, American Cast Iron Pipe Co., Birmingham, Ala.

The third session will be devoted to a discussion of gating and risering, and will be led by H. W. Dietert, foundry engineer, U. S. Radiator



CLEVELAND offers excellent facilities for the entertainment of foundrymen attending the 1930 convention. The Public Auditorium, shown at the left, has ample space to meet the demands of exhibitors and in addition has numerous meeting rooms. The New Union Terminal probably will be in operation at convention time

Corp., Detroit, a known authority.

Those attending the fourth session will deal with high-test irons, alloy additions and heat treatment of cast iron. H. Bornstein, metallurgist, Deere & Company, Moline, Ill., will lead the session and will be assisted by F. B. Coyle, research metallurgist, International Nickel Co., New York.

In addition to these round-table meetings and shop-operation course sessions, the usual sessions covering important technical and managerial phases of the foundry industry will be held.

The first formal announcement of the exhibit was mailed to former exhibitors on Dec. 7 and prior to Jan. 1 the total of space requested was 4000 square feet in excess of the total space used at the 1923 convention in Cleveland. Applications received since Jan. 1 and others that can be counted on for certainty assume the largest exhibit in the history of the association. The exhibit is scheduled to open at 10:00 a.m. Monday, May 12.

Copper Oxide Eliminates Aluminum

By J. H. Cheetham

OCCASIONALLY in our plant we get a 1500 pound heat of metal containing 85 per cent copper, 4 per cent tin, 5 per cent zinc and 6 per cent lead which is contaminated with approximately 1 ounce of aluminum per 100 pounds of metal. The aluminum is picked up from shop scrap which is overlooked in making up the mixture. The contaminated metal sometimes is poured into molds, particularly at night. This is due to the fact that in the day time, the presence of aluminum may be detected easily, but this condition is not so easily noticed under artificial light.

A series of tests were run to ascertain whether the contaminated metal could be purified after melting and before pouring. It is a well known fact that copper oxide and silica sand constitute one of the methods used by smelters to eliminate aluminum in bronze. Therefore, several test runs were made under varying conditions to determine the efficacy and practibility of this method in the foundry. In the first test run, 100-pound batches of the contaminated metal were remelted in an oil-fired crucible furnace. Our regular flux consisting of 1 pound of borax and ½ pound of rock salt was used. The metal was stirred well and skimmed and poured at 2100 degrees Fahr.

In the next test 5 pounds of copper oxide and 1½ pounds of silica sand were added before melting. Results were all right except that there was too much metal covering. This test was followed by one in which 3 pounds of copper oxide and 1½ pounds of silica sand were added after the metal was molten. Good results were obtained, but difficulty was encountered due to the fact that the copper oxide floated and was hard to force under the surface.

Then a test was run by melting the contaminated metal, stirring well and skimming without adding anything. Good results were obtained which showed that the borax and salt purified the metal during the melting operation. Such metal could be used in the regular heats, but it should be used with discretion in case it contains an excess dose of aluminum. However, since the tests enumerated necessitate remelting, it did not accomplish fully our desires as we wished to use the metal without cooling down and remelting.

With this in mind, some of the regular metal was taken from the furnace and 2 ounces of aluminum were added and stirred well. This gave a metal strongly contaminated with aluminum in about the same condition as obtained in the foundry. Three pounds of copper oxide and 1½ pounds of sand were added to this molten metal and stirred well. Results of this test were not so good as a little aluminum showed on the surface prohibiting its use for castings.

In the next test regular metal was taken from the furnace and 1 ounce of aluminum added and stirred well. This addition provided a metal about equal to the regular contaminated heats. Three pounds of copper oxide was added to the metal and stirred in well. Results showed that the castings obtained were all right, and that the method may be put to practical use. This test was followed by one in which regular metal from the furnace was contaminated by the addition of 1½ ounces of aluminum to give it a strong dose of this impurity. The contaminated metal then was poured into another ladle which contained 1½ pounds of copper oxide in the bottom and stirred well. Castings from this test were satisfactory. A peculiarity noticed was that metal contaminated with aluminum at 2100 degrees Fahr. has the same appearance as regular metal at 2000 degrees Fahr. As soon as the copper oxide was added and stirred in, the metal looked like the regular metal at 2300 degrees Fahr.

The last mentioned method may be put into practical use and gave better results than the preceding test as well as reducing the cost to show a saving over the remelting method. An estimated saving in using copper oxide against remelting the whole aluminum contaminated heat, basing copper oxide at 30 cents a pound and 1 cent a pound for total furnacing cost using oil and including fuel, labor and departmental overhead, is $8.20 for each 1500-pound charge.

Book Review

Transactions of the American Foundrymen's Association, Vol. XXXVII, 1929 edited by Robert E. Kennedy, cloth, 751 pages, 6 x 9 inches, published by the American Foundrymen's association, 222 West Adams street, Chicago, and supplied by THE FOUNDRY, Cleveland for $8.15, or in London by the Penton Publishing Co., Ltd., 415-17 Caxton House, Westminster, for 40s, postage extra.

This book contains a report of the proceedings of the thirty-third annual convention of the society, proceedings of the annual banquet, reports of the various committees and executives and the minutes of the meetings of the board of directors. The major portion of the book is devoted to papers presented at the various sessions of the convention and the reports of the joint committees with other societies. Both the papers and the reports contain much valuable information on foundry practice. Discussions of the various papers presented also are included.

Moves Cleveland Office

The Cleveland office of the New Haven Sand Blast Co. has been moved from the Erie building to 6536 Carnegie avenue. S. S. Parsons is western sales manager of the company in charge of the Cleveland office.

King Coal & Supply Co., Gay and Asquith streets, Baltimore, has been appointed representative for the Ironton Fire Brick Co., Ironton, O.

Compares Methods For Producing Electric Furnace Steel

By George Batty

THERE is not a uniformity of opinion as to the best method to be adopted in producing carbon steel for castings. Some makers hold that the best steel is produced by adjusting the components of the charge to produce a certain carbon content without it being necessary to induce a heavy boil, or even an appreciable boil, to bring the carbon to the desired figure. Other steel makers insist that the better method is to insure that every heat of plain carbon steel for castings be boiled, which involves the elimination of a considerable proportion of the carbon of the original charge. The author concurs with the latter view.

Believes in Boil

The first method is practically identical with the practice adopted in the manufacture of high grade crucible steels and it may be that if the same care were exercised, or exercisable, in respect to the constituents of a charge to an electric furnace as was considered essential in the crucible charge, there might conceivably be some real justification for the opinion held by the protagonists of this method that it is competent to produce a superior steel. In general, a steel foundry uses at least 30 per cent of its charge in the form of scrap such as gates and risers. Such scrap is contaminated with sand adhering to the metal. In the opinion of the author this feature alone is sufficient to demand the application of oxide of iron in some form to the bath that the steel be cleansed.

Adherent grains of sand may be broken into particles so fine that they are unable to rise through the liquid metal and become incorporated in the slag. For that reason, there would appear to be danger of finely divided silica in suspension in the metal of a charge which is melted, finished and poured without the introduction of such oxide of iron as will promote a boil. Included silica or silicates tend to reduce the ductility of the metal and certain failures of test bars may be identified with such nonmetallics.

In addition to the difficulty of ensuring a charge free from contamination by adherent silica, there also is a certain degree of trouble in securing other components of the charge free from scale or rust. Some steel makers refer to the method of melting at present under discussion as melting with high residual manganese and silicon.

Any iron oxide on the charge inevitably involves a reaction with the initial silicon and manganese of the charge and even though a perfectly clean charge be put into the furnace it usually is found that the material near the doors becomes heavily oxidized during the melting-down process through the induction of air at the door or ports. Attempts are made to seal the furnace and it is conceded that there is a possibility of protecting the charge from incidental oxidation during melting down but such procedure rarely is followed.

The condition arises in the so-called crucible method, of having a small proportion of free oxide in the charge which will react selectively with the silicon and produce silica. The silica so produced will be in a finely divided condition and therefore unlikely to levitate through the liquid steel to become part of the slag. Danger of the contamination of the charge with an undesirable nonmetallic constituent is apparent. Although the process may appear to be cheap in that it conserves silicon and manganese. It is open to serious criticism because of the liability of contaminating the charge with finely divided nonmetallics such as almost inevitably result in the ultimate product being depreciated in ductility. This point must be borne in mind when the production of certain alloy steels is considered.

Compares Methods

Molecular silica formed by a reaction between silicon and a small amount of oxide of iron, and the finely divided silica which adheres to the casting scrap of the charge, is unlikely to be levitated to the slag because the tiny particles do not coalesce readily. If we review the alternative method of producing steel in the electric furnace, that is, by oreing down to a low carbon, we insure a sufficient excess of iron oxide to form fayalite ($2FeO.SiO_2$) which more readily coalesces into pieces large enough to rise and become part of the slag.

It is admitted that in the process which involves oreing down to reduce the carbon to low limits, almost the whole of the initial silicon and manganese are converted to oxides. The

Discusses Conditions

METHODS for melting and finishing a heat of steel in the electric furnace and the different practices that must be used to produce plain carbon and alloy steels for castings are discussed in this article, which was abstracted from a paper presented at the Cleveland convention of the American Society for Steel Treating. The author also discusses the use of aluminum to eliminate porosity and blowholes in steel to be poured into green sand molds. He states that in his opinion moisture is the cause of pin holes in castings and that it is not a metal condition. The author of this article is research director, Steel Castings Development bureau, Philadelphia.

reaction of iron oxide with silicon and manganese proceeds at lower temperatures than does the reaction of iron oxide with carbon hence in the earlier stages of the melt, the reaction of iron oxide with certain constituents of the charge is selective in respect to silicon and manganese.

Insuring an excess of iron oxide over the amount essential to convert the initial silicon and manganese to silica and manganous oxide is of primary importance in cleansing the steel from nonmetallics and it is considered desirable by the author that the carbon content of a charge which is to finish at, say, 0.25 per cent, should be taken down, by oreing, to about 0.13 per cent or 0.14 per cent to insure, as far as is possible, the elimination of the products of the early reactions of iron oxide with silicon and manganese.

It is probable that some steel makers who use the boiling down method. counteract to a large extent the value of the method through the manner in which they finish the heat, by killing off the remnant excess iron oxide with small doses of ferrosilicon until the bath becomes quiet. The introduction of silicon to an over-oxidized bath will produce molecular silica, which, in the absence of a sufficient amount of iron oxide to form $2FeO.SiO_2$ will represent a serious contamination of the steel. Therefore, it is considered desirable to kill off the excess iron oxide with some carburizing medium that contains little silicon or manganese and for this purpose washed metal is recommended.

Uses Washed Metal

In an oxidized condition, a bath of steel is saturated with gas, but upon the introduction of a piece of cold scrap or pig iron there is an evolution of gas, presumably due to the physical effect of the material upon the saturated solution. The addition of washed metal, to an oxidized bath serves a double purpose in that it promotes a boil from purely physical action and continues the boil by supplying carbon with which the excess oxide of iron can react. This boil is evidence that the product of the reaction is gaseous and not solid, and it is the opinion of the author that it is sound practice to prepare a heat of steel for the addition of the *finals* by so treating the bath with washed metal or other low silicon low manganese pig iron. The boil will help the levitation of any finely divided nonmetallics which were suspended in the bath and so will tend to clear the bath of such undesirable constituents. It must be remembered, that the material which is added as a carburizer should itself be as low as possible in nonmetallic inclusions, and that an excess should not be used, otherwise the carbon content of the bath may be raised so that the addition of the final ferrosilicon and ferromanganese will raise the carbon beyond the desired limits. After the addition of the carburizer a sample is taken and quenched for fracture examination. This examination should precede the addition of the finals so that there may be a reasonable assurance that the material will conform with the chemical specification.

Some steel makers claim that they kill off a bath of steel, without the addition of ferrosilicon, by adding powdered coke or ground electrode to the slag. The author does not agree with this practice because the carbon does not go to the metal and reduce the oxide of iron in the bath direct, but a reaction is set up between carbon and silica in the slag near the electrodes, whereby silicon is produced and precipitated into the steel. Under such procedure silicon is the killing agent and inevitably produces silica in the metal. Another deleterious feature of killing off a bath of metal with coal additions to the slag is that the steel may come to the condition which has been described as over-reduced.

Slag Is Too Heavy

The ratio of slag to metal is quite an important matter in electric furnace practice and some operators are prone to have a slag that is too great in weight and volume, in relation to the weight and volume of the metallic bath. It frequently occurs that a melter observes, shortly after the addition of ore, that the slag has become thin and in some foundries it is fairly common practice for the melter to fear this condition and thicken up the slag with sand. Such procedure appears to be regular practice with some melters and is not justifiable if the whole of the facts are considered carefully. As a general rule the slag is thin because it contains an excessive amount of iron oxide and, as this oxide has been put into the furnace for a specific purpose, it should be allowed to exercise its function uninterruptedly until the reaction has been carried so far that a suitably low carbon is attained. The dilution of the slag with sand decreases the concentration of iron oxide in the slag and so tends to slow down the speed of the reaction between iron oxide and carbon in the bath. Excessive use of iron ore is to be deprecated, yet it must be admitted that many melters consistently use more ore than is necessary to complete the essential reactions because they have adopted the habit of building up a big slag by adding sand as soon as the slag appears to them to be too mobile. Instead of using a large ore addition, it is advantageous to use a smaller addition of ore and, as soon as this has been assimilated and a boil commences, to add limestone. Calcium is competent to replace iron to a certain extent in an acid slag. By the use of limestone, it is possible to limit the total amount of iron oxide in the slag and this is considered desirable. In open-hearth practice it is easier to secure a steady and regular carbon elimination when limestone is added to the slag than it is when no limestone is used. The same comment may be made justifiably in reference to acid electric practice. A limestone addition which will contribute a total of 8 per cent CaO to the slag is quite safe and such a slag is not so erosive to the banks as is a slag rich in oxide of iron.

Gives European Practice

European practice seems to favor, in both acid open-hearth and acid electric, a high proportion of MnO in the slag and a low proportion of FeO. This also is considered desirable as applied in the manufacture of steel castings and there seems no good reason why a certain amount of slag should not be re-charged to the furnace to build up the MnO content of the slag where the charge is of such a composition that the normal MnO content of the slag would be under 14 per cent. A slag which is low in MnO involves the steel maker in rapid losses of manganese from metal to slag when the final additions of ferrosilicon and ferromanganese are made, and melting under a slag fairly high in MnO tends to conserve the manganese of the charge.

The alloy steels to be discussed are those which are deemed low alloy steels, containing a maximum amount of metallic elements, other than iron, of 4 to 5 per cent. Of these the most common is the nickel-chromium series. Remelting nickel-chromium scrap in the acid furnace inevitably involves a considerable loss of the chromium content of the scrap. With the oxidizing method advocated for plain carbon steels, this loss is inevitable, yet it is not suggested that the "crucible" practice be adopted even though chromium might be saved. The same criticism of the crucible practice applies with alloy steels as it does with plain carbon steels where foundry

scrap is a considerable part of the charge and it is well to face the fact that certain elements are to be lost almost entirely from foundry scrap when remelted. Chromium, vanadium and manganese are readily oxidized and are lost from the metal to the slag. Titanium, if any, is residual in the steel and is oxidized readily. Nickel and copper do not suffer losses to any noticeable extent in remelting as scrap and molybdenum is considerably recovered if the furnace is kept tight during the melting period. However, if molybdenum-bearing scrap is allowed to become seriously oxidized before it is melted, there appears to be a definite loss of molybdenum through the volatilization of molybdenum oxide.

In the production of alloy steels, there is a greater proportion of loss on remelting scrap than there is on plain carbon steels and, in scrap that contains chromium or vanadium in combination with other metallic elements, these two elements are almost a dead loss to the steel maker. Hence, there may be a serious cost increment involved in such losses from remelted scrap. Because of the objections advanced against the crucible method of melting in the electric furnace, it is not deemed safe to advocate segregating alloy steel scrap and melting down a full charge of such scrap under conditions that would tend to conserve the special elements.

Makes Chrome-Vanadium Steel

In making chromium-vanadium steels, the bath should be brought to good condition of suitable composition except for the special elements before the ferroalloys are added and these should be added in small pieces, if a small furnace is being operated, and worked into the bath with a bar. The slag condition immediately before the additions of these special alloys should be adjusted carefully, but the over-reduced condition previously referred to must be avoided. A time sufficient to insure the entire digestion of the ferrochromium by the bath must be allowed before the heat is tapped from the furnace, and if the slag condition is poor there may be extravagant losses of chromium to the slag. With vanadium the losses would be even more serious and some steel makers prefer to add ferrovanadium in the ladle rather than in the furnace, taking precautions to ensure that the slag is held back in the furnace until practically the whole of the metal has flowed into the ladle.

Molybdenum may be introduced at any time to the charge, either as ferromolybdenum or as calcium molybdate. The latter is preferred and it is considered good practice to add the molybdenum when a good bath has been secured, but before the whole of the charge is completely melted. Nickel may be added at any time, but copper is added usually after the bath is completely melted.

There appears to be one danger attendant upon the use of copper but this usually is associated with a rather high phosphorus content and, in the author's experience, the trouble has been most marked in basic electric steel. It would appear that copper enters into combination with phosphorus to form Cu_3P which is not dissociated in the subsequent melting operations and occasionally steels are produced which appear inherently brittle particularly in the heavy sections where the phosphide of copper has an opportunity to form comparatively heavy boundaries to the crystal grains. This is largely an assumption.

Discusses Aluminum

In every open discussion in which the author has taken part in this country where steel castings were the subject under consideration, reference has been made to what is called the "low ductility problem" which, in particular, is identified with green sand castings. The Steel Castings Development bureau, through their associate at the bureau of standards, have in hand an investigation of this problem and, while such investigation is not completed, the author feels competent to express the opinion that the low ductilities are not primarily a metal problem insofar as melting operations are concerned. This is said because it has been proved repeatedly that metal which is competent to produce perfectly sound castings when poured in dry or skin-dried molds will not produce equally sound castings from straight green sand molds. The metal is identical as it enters each mold, hence the variant must be the mold. The only variant between the skin-dried green sand mold and the straight green sand mold is the moisture content of the sand at the face of the mold; hence we arrived at the conclusion that moisture is the primary cause of the pin hole trouble in green sand castings.

The pin hole problem and the problem of low ductilities are, in the opinion of the author, inevitably related to the moisture content of the sand and it is from this angle that the problem is being attacked. At the same time, numerous experiments are being conducted with deoxidizers other than aluminum with a view to finding a medium which, upon reaction with immigrant oxygen produces an oxide that is less deleterious than is alumina. It is not safe to attribute the whole of the reduced ductility to locally formed alumina, yet there can be no doubt that such alumina is a potent factor, probably the main culprit, in producing the less ductile condition.

Another point to be stressed is, that because certain castings of intricate design which have to be produced in green sand molds have shown ductilities of the order of only 18 per cent elongation instead of 24 per cent, there is no warrant for any assumption that this condition is representative of steel castings as a whole in that particular range of composition indicated by a particular specification. The condition has arisen primarily because the design of the casting is such that nothing but a green sand mold is a suitable medium to produce it free from cracks or checks. The low ductilities occasionally noted are associated with the fact that free aluminum must be added to the metal in order to react with immigrant gases from the mold and eliminate such blow holes, referred to as pin holes, as would be formed at re-entrant angles of the mold. The steel itself is inherently of physical properties superior to those revealed in a test bar produced under identical mold conditions with the casting or test bars cut from the casting, and quite a large proportion of the heavier type of castings that have to withstand arduous service are not subject to the same mold conditions and are comparatively immune from the deficiencies of light castings of intricate design.

Talks to Manufacturers

Dr. W. M. Steuart, director of the census, department of commerce, Washington, started on a nation-wide trip Jan. 16, to hold a series of conferences with the 600 census supervisors who will have charge of the forthcoming census of manufacturers, distribution, population, agriculture and mining. He was accompanied by Robert M. Davis, chairman of the publicity committee of the national advisory committee on manufactures and the national advisory committee on distribution. Mr. Davis will deliver addresses on the practical use of the census data to groups of manufacturers and distributors at luncheon meetings held under the auspices of local chambers of commerce and other trade and service organizations throughout the country.

Large Aluminum Sphere

Taxes Foundry Ingenuity

By Herbert R. Simonds

EVERY foundry occasionally is faced with an unusual job which taxes the ingenuity of foremen and molders. Such was the case in the recent molding and casting of an unusually large aluminum sphere designed to be decorated with a map of the world and mounted in the lobby of the new *Daily News* building, New York. The problem of making this casting was delegated to Andrew Masterton, assistant superintendent, United Dry Docks foundry, Staten Island, N. Y. This foundry is devoted principally to large miscellaneous work, mostly gray iron castings for marine service. It was established in 1915 by the Staten Island Ship Building Co. to provide a foundry located near the shipbuilding plant. Since that time the foundry has employed about 25 molders on the average.

Describes Class of Work

The class of work turned out has varied from propellers and marine cylinders to weights for balancing stage scenery. The latter item is a specialty which was developed at a time when marine work was slack. The average theater uses 16 tons of these weights and the firm recently shipped 35 tons of stage weights to the new auditorium at Atlantic City, N. J. Another product made in the United Dry Docks foundry is large iron kettles for melting purposes. One of the kettles is shown in Fig. 4.

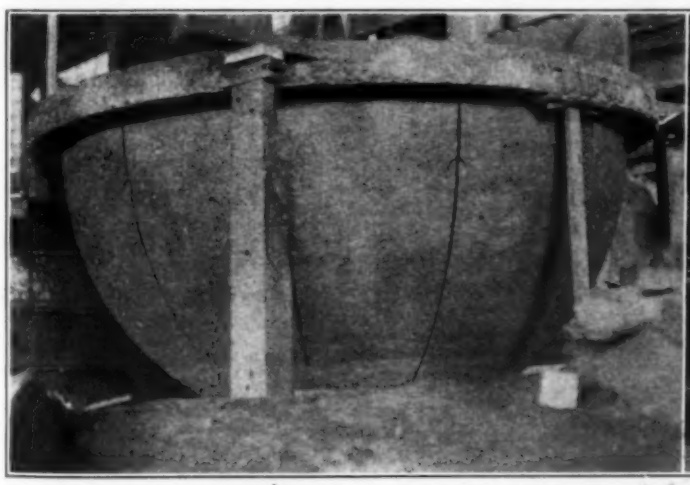
The foundry is equipped with two cupolas and two cranes with capacities of 10 and 20 tons respectively. Production in the foundry averages about 20 tons of gray iron castings a day, and occasionally single castings 20 tons in weight have been made. The average run of marine work calls for a considerable amount of bronze and aluminum castings, and this type of work is cast in a separate department. The nonferrous department is equipped with a tilting furnace manufactured by the Monarch Engineering & Mfg. Co., Baltimore, for brass melting, and a 500-pound aluminum furnace supplied by the Alfred Fisher Furnace Inc., Chicago.

While Mr. Masterton never had made an aluminum casting weighing over 500 pounds in his foundry, he was accustomed to making large gray iron kettles. A rough estimate showed that the castings for the 12-foot diameter, aluminum sphere would weigh around 2000 pounds, and it was decided to make it in two parts instead of a large number of sectors. Although that method would be a little more difficult to mold, the amount of machining would be reduced considerably. The wall thickness of the castings was set at ½-inch and each half section was to have eight interior reinforcing ribs arranged longitudinally. Before the work actually was started, the drafting department made drawings showing dimensions, location of the ribs and other working details.

Starts the Mold

The first step in the foundry was to dig a pit somewhat larger than the casting and similar in shape. This pit then was backed with brick and coated with a mixture of gravel and Jersey molding sand. While the coating used is unusual for aluminum molding, it worked satisfactorily. An accurate sweep was constructed to give the proper contour to the mold surface. Following the usual practice in this type of work, the spindle for the sweep was located perfectly true and at right angles to the parting surface. After sweeping up the mold to the proper diameter, a thin coat of slurry was applied to the mold face and swept into place with the sweep operated in the opposite direction. This leaves a nice, smooth surface on the mold.

The mold then was left to dry overnight, and attention was turned to making the cope. Part of the cope was made on the floor and the remainder in the pit mold. A crown plate shown in Fig. 3 a little over



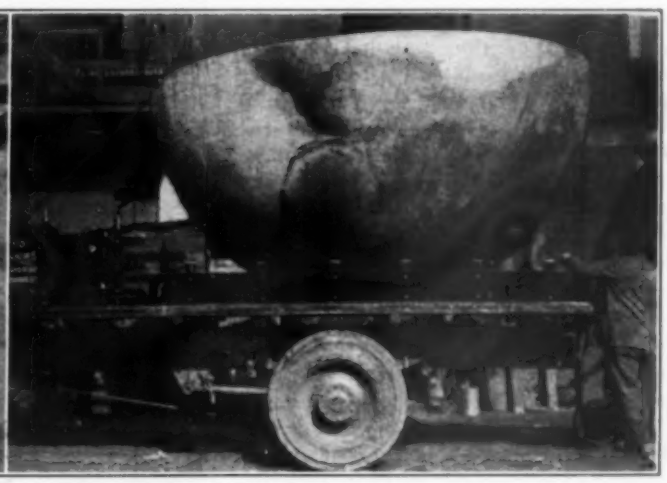


FIG. 1—FINISHED COPE OF THE MOLD BLOCKED UP ON THE FOUNDRY FLOOR. FIG. 2—COMPLETED HALF OF THE SPHERE WEIGHS 2200 POUNDS

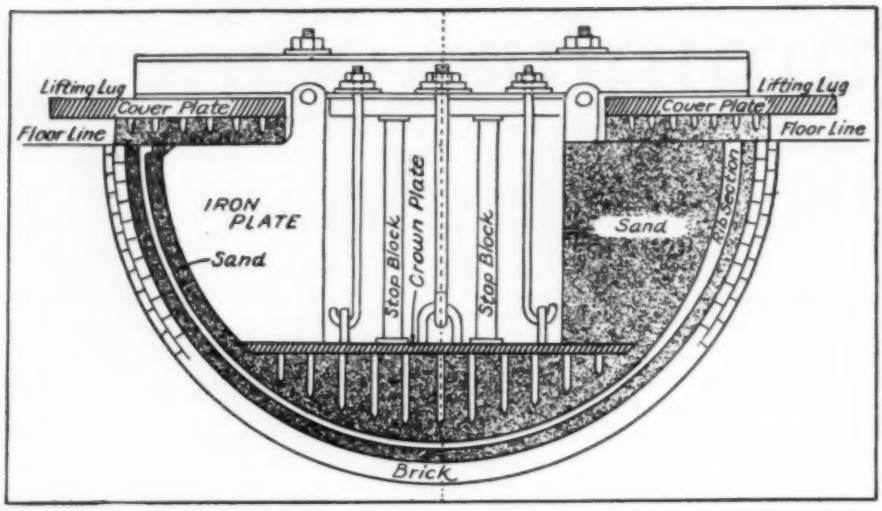


FIG. 3—DIAGRAMMATIC SKETCH SHOWING SOME OF THE CONSTRUCTION DETAILS OF COPE

8 feet in diameter and 2 inches thick was cast. The crown plate as shown formed a support for a network of reinforcing bars and wires. It was placed on the floor with the bars and wires up and the sand consisting of 50 per cent floor sand and 50 per cent Jersey molding sand rammed into place. After ramming the sand was swept up to shape.

Uses Lagging Strips

After the drag had dried, the interior was lined with lagging strips ½-inch thick to give the proper metal thickness. The crown plate with its covering of sand then was rolled over and lowered into the drag where it rested on the lagging strips. The rest of the cope then was built up as shown diagrammatically in Fig. 3. The upper part of the cope above the crown plate had to be strong and at the same time arranged for a speedy destruction to allow the aluminum alloy to contract without tearing or cracking.

The scheme used was the employment of 12 flat plates of special design equally spaced around the circumference of the cope. The lower ends of these plates rested on the crown plate and the upper end containing a lug extended above the cope proper and inside the cover plate. The lugs filled a double purpose. They provided a means of wedging against the cover plate, and after the casting was poured, permitted withdrawal of the plates so that normal construction of the casting could take place. The part of the cope above the crown plate then was rammed with the same mixture of sand as was used below the crown plate. Lugs and wires loosely held between the vertical plates supported the sand without interfering with removal of the plate. The center of the cope was left open as the sand just came to the inner edges of the vertical plates.

The estimated weight of the cope when completed including the cover plate and the crown plate was 20 tons. It was realized that this weight would put a severe strain on the cover plate and possibly might allow the cope to sag. Therefore, when the crane hooks were fastened to the outside lugs of the cover plate preparatory to withdrawing the cope, the lifting effect was observed carefully. Before the cope was entirely suspended, it was noticed that the cover plate had sagged about ¾-inch in the center. The cope then was lowered to its original position, and a heavy I-beam cross member was fastened to the cover plate so that it took up the sag at the center.

The cope then was lifted from the drag and blocked up on the foundry floor as shown in Fig. 1. The mold surface was finished carefully and then coated with lead and molasses water and allowed to air dry. While the cope was drying, the lagging strips were removed from the drag which was examined for condition. Rolls of clay ½-inch thick were placed on various parts of the drag and then the dry cope was lowered carefully into place. The cope was lifted and after a few minor corrections again was lowered into the drag which had the clay thickness rolls in place. Examination of the cope after lifting again showed that the corrections made would give a uniform thickness of metal in the casting. The cope was dried thoroughly and again tested with clay thickness strips to see that it had held its shape.

Melts the Metal

Since the regular furnace used for melting aluminum was much too small for casting the hemisphere, an improvised furnace was constructed. This consisted of one of the large gray iron melting pots, held at the foundry as a pattern. This pot was set in a brick enclosure. To be on the safe side a charge of 2500 pounds consisting of half commercial scrap and half ingot aluminum was melted. Heat for melting was supplied by wood and coke fire and an oil torch. When the metal reached the desired temperature the iron pot was lifted by a crane from its improvised founda-

(*Concluded on Page* 128)

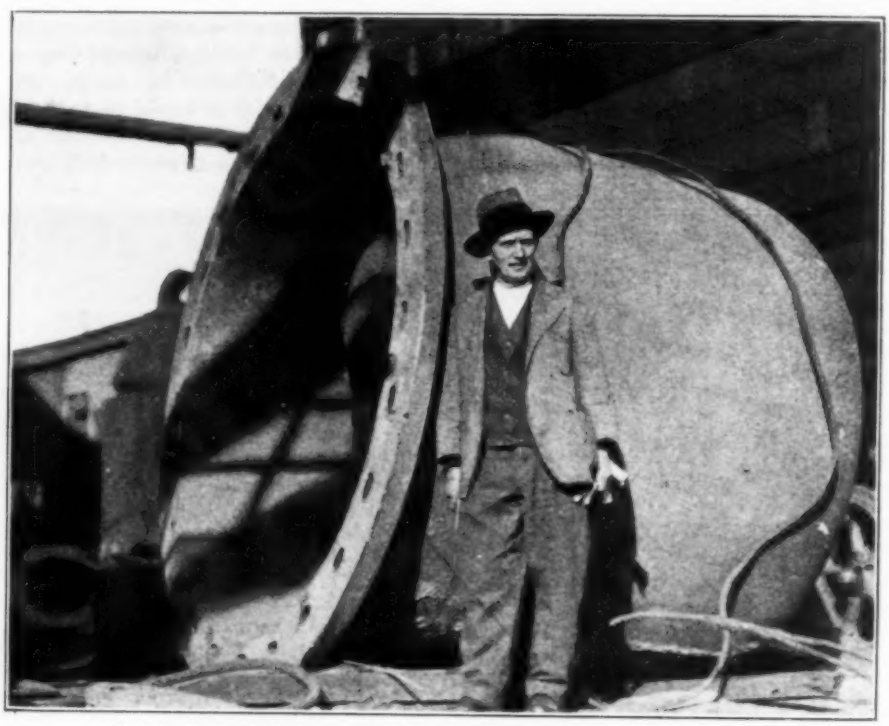


FIG. 4—THE FIRM MAKES MANY LARGE GRAY IRON MELTING POTS

Fundamentals of
FOUNDRY PRACTICE

Sand Is Rubbed and Mixed Thoroughly to Distribute the Silica and Binding Material as Uniformly as Possible

By Ivan Lamoureux

Interpreted in the Light of American Practice by Pat Dwyer

Part III

AFTER it has been crushed, mixed and screened, the sand is tempered or wetted to give it the consistency required in molding. In the manual preparation of sand, it is simply wetted with a bucket or sprinkler, and then worked over with a shovel. In the mechanical preparation of sands, special equipment is used which permits tempering the sand as required.

Fig. 27 represents a combination sprinkler and mixer composed of a semi-cylindrical trough in which a revolving shaft armed with paddles is driven by the pulleys *A*, and turns in the bearings *B*. The sand is introduced into the chamber at the pulley end. The water from the reservoir *C*, passes through a pipe which is perforated with a number of holes through which the water drops into the sand chamber. The paddles, arranged in the form of a propeller, turn the sand over, mix it and conduct it to the other end of the mixer where it is discharged through the door at the bottom of the chamber.

Fig. 28 represents a mechanical pug-mill used for mixing sand and loam for facing the patterns. A chilled iron propeller *A* revolving in a sheet-metal trough *B*, mixes thoroughly the different materials put into it. After the mixing is completed, the sand is dumped out of the trough by an arrangement which permits turning the trough over without stopping the machine. This dumping arrangement is the same as that on carts used for hauling mortar for masons.

Sand Mixers

IN a few small foundries the facing sand still is mixed laboriously by hand. At one time all the sand in the foundry, facing sand, core sand and heap sand was prepared in this manner, but with the rapid adoption of mechanical equipment in recent years and the gradual increase in the size of the foundry units the conditions have been reversed. Many of the smaller foundries and all the larger foundries depend on mechanical equipment for the preparation and distribution of the sand. Impartial attention is directed by text and illustration to several types of mixers in which sand is prepared for the molder's use.

The purpose of rubbing and mixing the sand is to distribute the silica and alumina as uniformly as possible throughout the whole mass, and to thus impart to it all of the cohesiveness.

To obtain this result in the preparation of sand without a machine, the sand mixer tramples and rubs the sand with his feet. The molder who prepares the sand by hand, takes a small quantity and rubs it between his fingers to distribute uniformly the different elements constituting the sand.

Mechanical rubbers include: Cylinder rubbers, rubbers with rotary bowls, rubbers with hollow spheres.

The old cylinder rubbers are composed of a double row of cylinders superimposed in groups of two, one beside the other. The crushed sand enters the first two cylinders, drops down between the next two, which revolve at different speeds, and dropping thus from cylinder to cylinder, it finally accumulates below the machine. Scrapers continually return the sand which drops from the cyl-

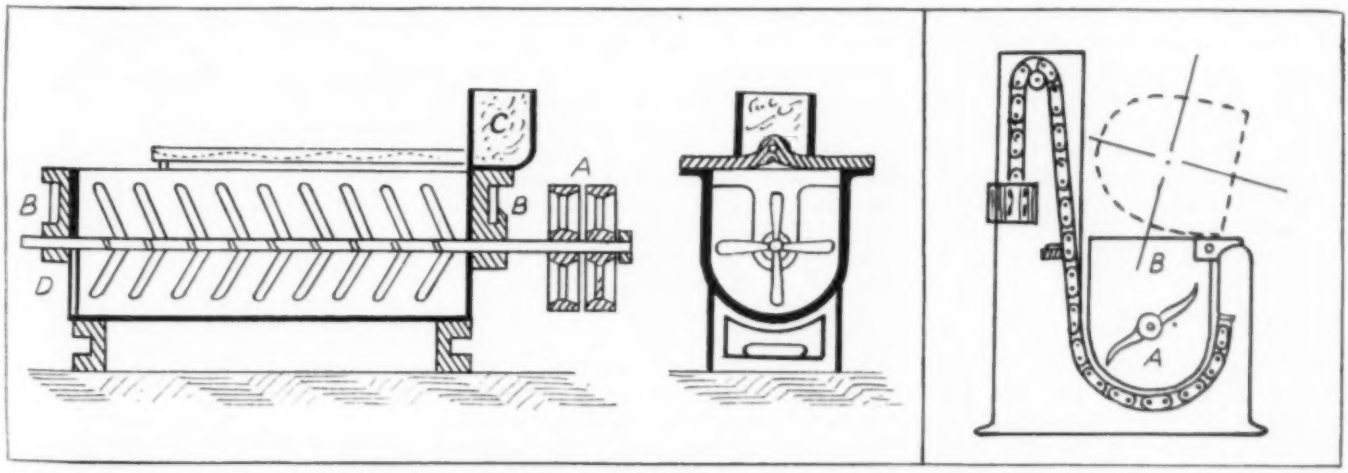


FIG. 27—IN THIS TYPE OF SAND MIXER THE MATERIAL IS AGITATED THOROUGHLY BY A NUMBER OF PADDLES ATTACHED TO A ROTATING CENTRAL SHAFT. FIG. 28—ONE METHOD OF DISCHARGING THE LOAD

FIG. 29—ONE OF THE MANY TYPES OF PADDLES EMPLOYED IN TROUGH MIXERS

inders. As a general rule the output of such machines is not great, and clods are formed which are hard to screen.

Rotary rubbers are similar to the rotary mills but the flat rollers are replaced with light, suspended, grooved rollers. Rakes turn the sand over constantly and in that manner all the particles are subjected to a thorough rubbing. Scrapers remove the sand sticking to the rollers. Rubbers with hollow spheres correspond to the mills described previously and shown in Fig. 21.

Sand Cutting

Cutting the sand completes the mixing of its various component elements and makes it porous and mellow.

The cutter shown in Fig. 30 is the oldest cutter known and is still used in large numbers of foundries, where it gives good results. It consists of two vertical disks *D* as shown, containing a series of horizontal pegs on two different diameters of circles, in the form of a squirrel cage. The two disks revolve in opposite directions, the pegs of one circle passing between the pegs of the other, and thus thoroughly divide the lumps of wet sand. After the sand is introduced into the hopper *B*, it is subjected to jolts from the various pins, it then drops into a trough and is stored below the machine. Each disk revolves at an actual speed of 600 revolutions per minute, producing a relative speed of 1200 revolutions per minute as they revolve in opposite directions.

The cutter just described is one of the oldest cutters used in foundries. However, the original type as shown in Fig. 30 has been improved. In some of the improved cutters, the pulleys which drive the two disks are placed on the same side of the machine, the first mounted on a hollow shaft, and the second on a shaft which revolves inside, as shown in Fig. 31. Other cutters resembling this type have but one disk with pins.

The single disk cutters clog easily. The sand thrown off the pins piles up on the inside of the machine and acts as a brake. It is then necessary to open the machine and knock off the accumulated sand. A sand cutting machine to be really practical should never clog and its output should be such that a man would find it difficult to keep up with it.

The horizontal cutter, Fig. 32, consists of an upright shaft *A*, which rotates on the inside of a cast-iron frame *B*, and which turns a sort of squirrel-cage, attached to the lower plate *C* and connected to the upper plate *D*, by a series of strong steel pins. A hopper *E* is attached to the top of the base by four heavy bolts. The vertical shaft which rotates at a speed of 600 revolutions per minute is driven by a pulley *G* attached to the shaft. A horizontal belt is protected by a sheet metal cover.

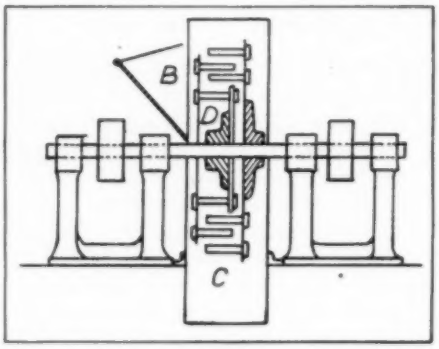


FIG. 30—SAND FALLS BETWEEN TWO VERTICAL DISKS EQUIPPED WITH PROJECTING RODS AND REVOLVING IN OPOSITE DIRECTIONS

The outside cover, sheet-iron, leather or canvas is secured to the base. The sand introduced into the hopper is thrown violently among the pins which divide it and throw it against the cover whence it drops to the ground. A cutter of this type gives good results.

The brush cutter shown in Fig. 33, consists of a circular metal brush which runs at high speed (600 revolutions per minute) and throws off the fine sand. This cutter gives good results because the sand has been screened to remove all metallic substances which would injure the brush. The machine previously described and illustrated in Fig. 7 is equally well adapted for cutting sand.

In foundries where large quantities of sand are used for facing, automatic sand preparing equipment is installed. The apparatus is installed on the different floors. The machines are arranged in the sequence in which the various operations are performed. The sand, old and new, is raised by chain buckets and dumped automatically into the first machine. The sand passes successively and automatically to each of the others, and finally accumulates in the bins which have openings at the bottom, and from which the molding sands are supplied to the various molding floors.

In an installation of this kind, where no shoveling is required, an enormous output can be obtained with the service of two or three men. All the equipment of an automatic sand preparing plant should be cleaned, oiled and gone over at least once every day. The output is high, therefore, the sand plant can be shut down without causing any inconvenience for the two hours required to go over the entire equipment.

As a precautionary measure, some automatic sand plants have two or three other machines for preparing sand in reserve.

Before mixing the old sand with the new, it is advisable to pass it through a magnetic separator, which removes any pieces of iron that may be in it. These machines are expensive, but they require very little power to operate and enable one to recover a considerable amount of iron, which would be lost without them.

Constructive Details

The magnetic separator, Fig. 34, consists of a hollow copper drum, which revolves on two hollow spindles mounted in bearings. On the inside of the drum, an electro-magnet is attached to a shaft which passes through the hollow spindles of the drum. The cable for the magnet also passes through the latter spindles. A hopper *A* receives the sand and diverts it into an oscillating trough or channel *B*, which in turn spreads it as uniformly as possible over the surface of the drum. As the particles of sand slide over the drum on their way down to *C*, the pieces of iron contained in it, due to the magnetic attraction, cling to the drum and remain there as long as the attraction continues to be felt and do not drop off until they reach the division *D* separated from the sand.

Tradition and custom and to some

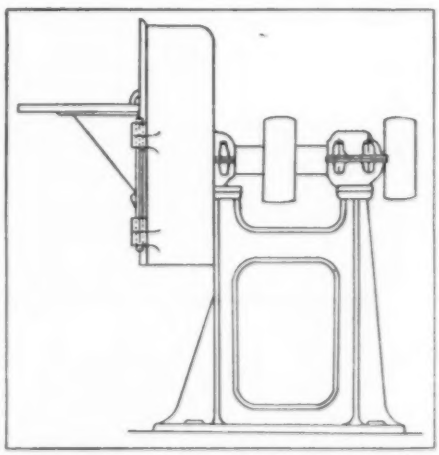


FIG. 31—OPPOSING DISKS ARE DRIVEN BY ONE SHAFT INSIDE ANOTHER

extent, the conservative attitude which seems to characterize the foundry industry probably account for the great variety of mechanical sand mixtures still in use in European foundries. Probably mechanical equipment is used more extensively in American foundries than elsewhere, but the choice of devices has been limited to a smaller number. Also a difference is observed between the equipment devoted to the preparation of the facing sand and the remainder of the sand employed to fill the flasks. In this connection it is interesting to note that facing sand and core sand are prepared in the same types of machines. In many instances they are prepared in alternate batches in the same machine.

Cuts the Sand

Heap sand designed to be left in long piles on the floor is cut over and mixed by an electric or gasoline driven machine mounted on high wheels and equipped with a set of revolving steel blades which scoop the sand from the floor, flirt it through the air in a manner approximating the action imparted by a shovel in the hands of a skilled molder and deposit it in the usual long pile, or, *kick* it up in a compact pile close to the molding machine or bench. This machine travels under its own power when equipped with a gasoline engine. The electrically equipped machine takes its power through a flexible cable attached to a suitable socket in the wall or column of the building. The cable is wound upon a drum which automatically takes up the slack or releases it as the machine moves from point to point on the floor.

A machine which mixes, aerates, removes lumps and throws the sand into a container or to any designated point on the floor is employed for mixing either heap sand or facing sand. The sand is shoveled into it through a screen which catches gaggers, scrap or lumps of hard sand. An inclined belt equipped with projecting members and traveling at high speed disintegrates the sand and throws it a considerable distance in a clean, aerated condition. In a second machine a revolving head throws the sand, while in a third machine the sand passes over a rapidly revolving steel or iron drum armed with small knobs and thence through a brush. These machines are employed independently or in connection with other pieces of sand mixing apparatus.

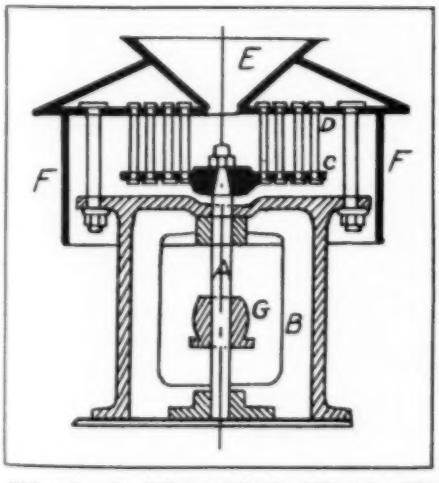


FIG. 32—IN THIS DEVICE THE PLATES WITH THE RODS REVOLVE HORIZONTALLY

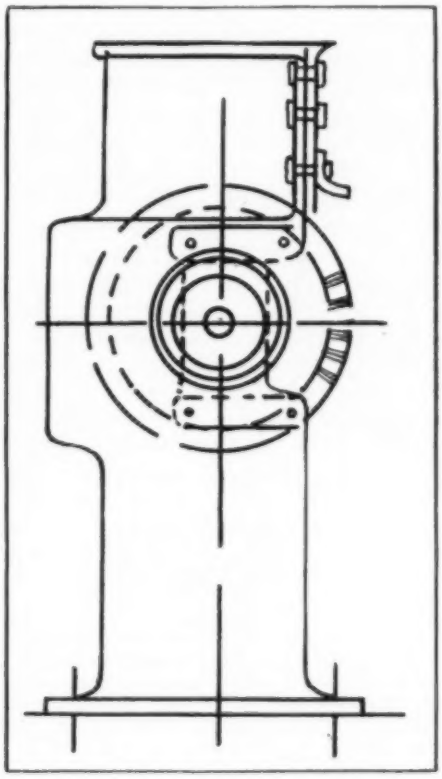


FIG. 33—A METAL BRUSH RUNNING AT HIGH SPEED DISINTEGRATES THE SAND

Two forms of pan mills are employed extensively. In one the pan remains stationary while the rollers revolve. In the other the pan revolves while the roller or rollers remain in the same relative position to the supporting structure. Plain, cylindrical rollers are employed irrespective of whether the pans are of the stationary or revolving type. The rollers are equipped with hard iron or hard steel tires which may be removed and replaced by others when worn. The rollers in the revolving pan are driven from above through suitable shaft and bevel gearing supported on a yoke which spans the pan. The rollers in the stationary pan are driven from below either through a pulley and shaft or direct electrical drive. Sand from the stationary pan is discharged through an opening in the side or bottom. Sand from the revolving pan is discharged over the top by the simple expedient of holding a plow in position.

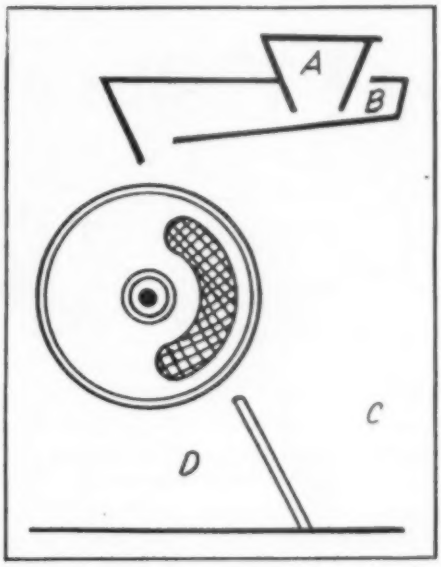


FIG. 34—THE MAGNETIC SEPARATOR REMOVES METALLIC INCLUSIONS FROM THE SAND

Mills Used Individually

This type of sand mixer is used independently to mix individual batches of facing or core sand. It is also employed in connection with continuous sand handling systems in which the same body of sand is utilized several times each day. In the former instance the sand is loaded either by shovel or by a loading pan attached to a suitable hoist. A definite amount of sand and any other necessary ingredients are placed in the pan which then is hoisted and the contents spilled into the mixer. In this manner close control may be exercised over the mixture. Usually where the mixer forms an integral part of a continuous system, the sand is fed from overhead hoppers. A water spray system also is installed by which a measured amount of water may be added. Liquid core binder is added in the same manner to core sand mixtures.

Centrifugal action is taken advantage of in a machine made up of a revolving horizontal plate studded thickly with upright steel pins, enclosed in a sheet steel hood and fed through a funnel in the center of the top side. Sand may be fed either by the shovelful or from a chute connected to an overhead hopper. Sand falling on the center of the plate is driven toward the cir-

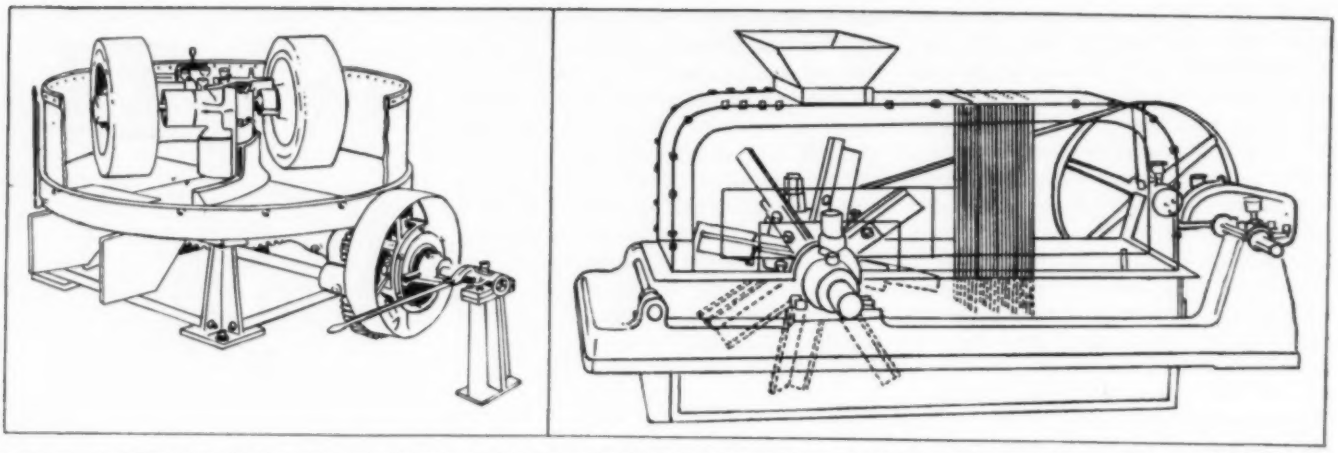


FIG. 35—ROLLERS REVOLVE ON THEIR OWN AXIS AND TRAVEL AROUND THE PAN WHILE THE PAN REMAINS STATIONARY. FIG. 36—SAND FALLING THROUGH THE FUNNEL ON TO A PADDLE WHEEL IS DRIVEN THROUGH A MAZE OF HANGING RODS

cumference by centrifugal force. On the way it encounters the maze of steel pins and as a result it falls over the edge of the plate and inside the hood in a workable condition.

A variation of this idea has been adopted in many foundries where the sand is kept continuously in motion. The sand from a moving belt falls upon a revolving paddle wheel. The wheel throws the sand with considerable force through a labyrinth of steel rods suspended from the cover of a chamber. The sand falls upon a second belt which carries it to the storage bin. One end of the cover is hinged to the frame and the other end is lifted a few inches with each revolution of a small camshaft and allowed to fall back into place with a jerk that prevents the sand from sticking to the rods.

A metal trough containing a revolving shaft armed with few or many paddles is employed principally for mixing core sand, but it is also used to some extent for mixing facing sand. Methods for measuring the batch and placing it in the trough vary in individual installations depending on the quantity to be handled. Auxiliary devices usually are attached for measuring and discharging the correct amount of water and core binder. In one type the paddle shaft turns 20 revolutions per minute. Thus with 32 paddles the sand is tossed 640 times each minute or 1920 times during the 3 minutes usually devoted to each batch. The finished material is discharged through an opening in the bottom. In another machine of the same general type, but in which the shape of the paddles constitute the principal features of difference, the trough is mounted on trunnions and is tipped over to discharge the contents.

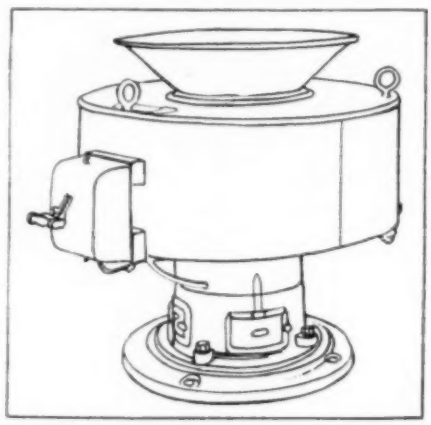
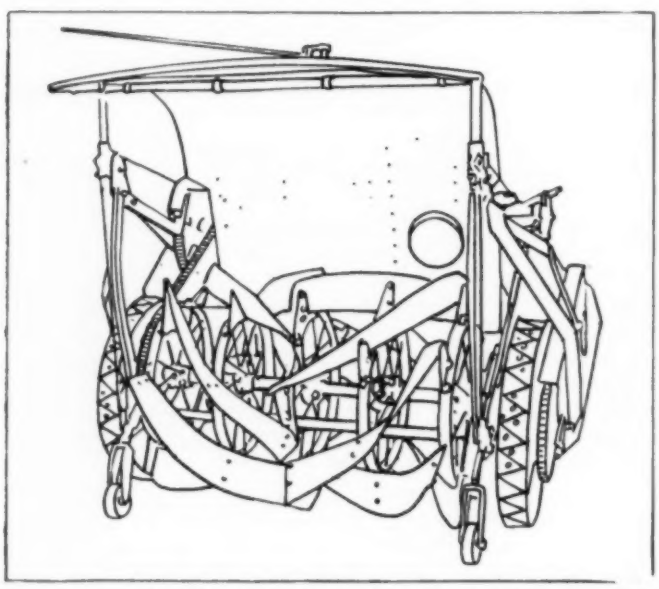


FIG. 37—SAND FALLING THROUGH A HOPPER ON TO A REVOLVING HORIZONTAL PLATE IS DRIVEN TO THE OUTSIDE BY CENTRIFUGAL FORCE

J. J. Hartley, formerly in charge of foundry equipment sales, western division, Link-Belt Co., Chicago, has been appointed chief engineer of that company's Pershing road plant, Chicago. Through an error it was stated in the Jan. 1 issue of THE FOUNDRY, page 118, that Mr. Hartley was connected with the Link-Belt Co., Milwaukee. This should read Link-Belt Co., Chicago.



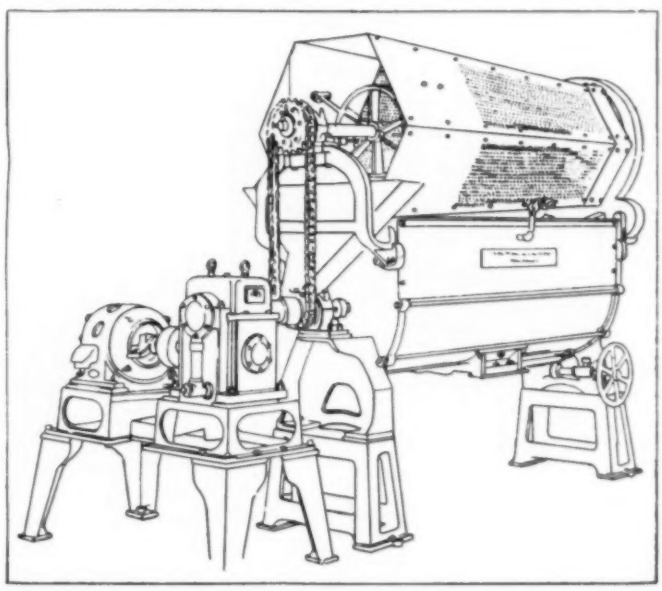


FIG. 38—THE REVOLVING BLADES ON THE CYLINDER CUT THE SAND IN THE HEAP. FIG. 39—SELF CONTAINED ELECTRICALLY OPERATED TROUGH TYPE SAND MIXER IN WHICH THE SAND IS MIXED BY REVOLVING PADDLES

Unify Gray Iron Costs

Gray Iron Institute, After Year of Study and Research, Offers Standard Cost System to Industry

A STANDARD cost system for gray iron foundries recently was presented to the industry by the Gray Iron institute. This system, which was developed by the cost committee of the institute, represents the best features of numerous individual and group cost plans which now are in use. Through the cooperation of the institute, THE FOUNDRY is publishing the standard cost system in three installments. The first section, which deals with cost division of the foundry, definitions of departments and the classification of accounts in the melting department and the molding department for small foundries, was presented in the Jan. 15 issue. The material in this, the second installment, continues with the classification of accounts.

2. Molding Department—(System B Procedure For Heavy Foundries)

2 A. Distribution on Direct Labor Basis

21 Molding Direct Labor (Labor basis—heavy foundries): Molders, apprentices, helpers, rammers, finishers, core setters, includes pouring time if pouring is done by molders or helpers.

22-2 Molding indirect labor (Labor basis—heavy foundries): All other labor in the molding department except cranemen and sand shed labor, such as pouring, if done by separate pouring gang, delivering metal to floors, transporting castings, sprues, patterns, flasks, boards, bands, etc.

25 Flasks (Labor basis—heavy foundries): Labor and material used for making, altering, or repairing wood or iron flasks, bottom boards, plates, squeeze boards, bands, jackets, etc., which are not charged direct to customer. Whenever possible the cost of special equipment should be charged direct to the customer.

26 Patterns (Labor basis—heavy foundries): All patternmaking labor and materials for making, altering or repairing patterns, mounting on boards, plates, etc., which are not charged direct to customer. Whenever possible the cost of equipment should be charged direct to customer.

28 Foremen and clerks (Labor basis—heavy foundries)

29 Share of General Overhead (Labor basis—heavy foundries)

29-1 Fixed charges.

29-2A Heat and light.

29-3 General expense.

2 B. Distribution on Tonnage Basis

22-1 Molding Indirect Labor (Tonnage basis—heavy foundries): Cranemen, sand shed labor.

23-2 Molding Sand (Tonnage basis—heavy foundries): Cost of molding sand including freight, cartage and unloading.

23-3 Miscellaneous Supplies and Tools (Tonnage basis—heavy foundries): Plumbago, brick, fuel for dry sand ovens, fuel to dry pit molds, nails, bar iron and steel gaggers, silica flour, molasses and glutrin, sea coal, lubricants, waste, air hose and fittings, electric bulbs, bolts, clamps, shovels, riddles, fire clay, flour, dextrine, other compounds used in molding sand mixtures, facing, brushes, lumber, rammers and rammer butts, tools, parting.

27 Repairs (Tonnage basis—heavy foundries): Labor and materials used for making repairs to all equipment in the molding department, except flasks and patterns.

29-2B Power (Tonnage basis—heavy foundries)

3. Core Department

31 Core Direct Labor: Coremakers, apprentices, and other labor in the core department that can be specifically followed and charged direct to a job.

32 Core Indirect Labor: All other labor in the core department such as mixing core sand, tending core oven, cranemen, transporting core sand, core boxes, and cores.

33-1 Fuel: Cost of fuel for core ovens including freight, cartage, and unloading.

33-2A Core Sand: Cost of core sand including freight, cartage, and unloading.

33-2B Core Materials: Core oil, flour, molasses and glutrin, core compound, dextrine.

33-3 Miscellaneous Supplies and Tools: Nails, bar iron and steel, rods, plates, core wire brushes, air hose and fittings, incandescent lamps, lumber, shovels, riddles, fire clay, bolts, rammers and rammer butts, tools, chaplets, when used excessively, charge direct to job.

37 Repairs: Labor and materials used for making repairs to all equipment in the core department.

38 Foremen and Clerks.

39 Share of General Overhead:

39-1 Fixed charges.

39-2 Heat, light and power.

39-3 General expense.

4. Cleaning and Shipping Department (Simplified Method)

Note: The following is a simplified method for determining the costs in the cleaning and shipping department. The advanced method defined in the next section is recommended by the institute cost committee as a method more adaptable to foundries wishing to secure direct, accurate cleaning and shipping costs on individual jobs.

42 Cleaning, Finishing and Shipping Labor: All labor in cleaning and shipping department such as: tumbling, sandblasting, pickling, digging out cores, chipping, grinding filing, sorting, inspecting, gaging, packing, shipping, weighing, loading trucks, welding, moving castings, clean-up labor.

43 Miscellaneous Supplies and Tools: Grinding wheels, chisels and cutters, blasting abrasives, stars and jacks, oxygen and acetylene, welding torches and tips, chipping hammers, air hose and fittings, blasting hose and nozzles, bags and barrels, crating lumber.

47 Repairs: Labor and materials used for making repairs to all equipment in cleaning and shipping department.

48 Foremen and Clerks.

49 Share of General Overhead.

49-1 Fixed charges.

49-2 Heat, light and power.

49-3 General expense.

4. Cleaning and Shipping Department (Advanced Method)

4-A. Cleaning Department

Note: The following further subdivision of the cleaning department is made for the purpose of figuring a separate overhead percentage on tumbling 4AT, sandblasting 4AS, and pickling 4AP, since overhead items such as supplies, power, and depreciation of equipment may vary considerably on sandblasting, tumbling and pickling. Each of these departments would carry a complete set of accounts.

4-AT. Tumbling Department

41-AT Tumbling direct labor.

42-AT Indirect labor.
43-AT Miscellaneous supplies and tools.
47-AT Repairs.
49-1-AT Fixed charges.
49-2-AT Heat, light and power.
49-3-AT General expense.

4-AS. Sandblasting Department
41-AS Sandblasting direct labor.
41-AS-1 Mill operators.
41-AS-2 Hand sandblast.
41-AS-3 Table sandblast.
42-AS Indirect labor.
43-AS Miscellaneous supplies and tools.
47-AS Repairs.
49-1-AS Fixed charges.
49-2-AS Heat, light and power.
49-3-AS General expense.

4-AP Pickling Department
41-AP Pickling direct labor.
42-AP Indirect labor.
43-AP Miscellaneous supplies and tools.
47-AP Repairs.
49-1-AP Fixed charges.
49-2-AP Heat, light and power.
49-3-AP General expense.

4-B. Finishing Department.
41-B Finishing direct labor.
Grind, chip, file, gage, testing.
42-B Indirect labor
Sort, inspect, welding, moving castings.
43-B Miscellaneous supplies and tools.
47-B Repairs.
49-B Share of general overhead.

4-C. Shipping Department
42-C Labor, packing, shipping, weighing, loading.
43-C-1 - Barrels and containers.
Note: Whenever possible, the cost of containers should be charged direct to customers.
43-C-3 Miscellaneous supplies and tools.
47-C Repairs.
49-C Share of general overhead.

CLASSIFICATION OF ACCOUNTS in AUXILIARY DEPARTMENTS

Note: It is entirely optional with each local foundry whether or not these auxiliary departments are used. They are shown here in detail only for the convenience of the foundries which may desire to use them. Their elimination will in no way interfere with the successful operation of this cost system.

5. Carpenter Shop
50 Lumber.
51 Direct Labor.
53 Supplies and Tools.
55 Carpentry Work Purchased Outside.
57 Repairs.
59 Share of General Overhead.
59-1 Fixed charges.
59-2 Heat, light and power.
59-3 General expense.

6. Pattern Shop
60 Direct Pattern Material.
61 Direct Labor.
62 Indirect Labor.
63 Supplies and Tools.
65 Pattern Work Purchased Outside.
67 Repairs.
69 Share of General Overhead.
69-1 Fixed charges.
69-2 Heat, light and power.
69-3 General expense.

7. Maintenance Department
71 Direct Labor.
73 Supplies and Tools.
75 Outside Work.
77 Repairs.
79 Share of General Overhead.
79-1 Fixed charges.
79-2 Heat, light and power.
79-3 General expense.

8. Heat, Light and Power Department
80 Coal
82 Labor.
83 Supplies and Tools.
84 Power and Light Purchased.
87 Repairs.
89 Share of General Overhead.
89-1 Fixed charges.
89-2 Heat, light and power.
89-3 General expense.

GENERAL OVERHEAD AND EXPENSES

1. Fixed Charges

110 Taxes:—Real, personal, and all other taxes except federal and state income taxes.

111 Insurance:—All insurance for fire or property damage.

112 Depreciation on Buildings.

113 Depreciation on Equipment.

2. Heat, Light and Power

120 Heat:—Cost of all fuel, labor, supplies and tools, repairs, and depreciation in boiler and engine room.

121 Light and Power:—Cost of all electric power, whether purchased or produced in local plant. If power is produced in private plant, cost of all fuel, labor, supplies and tools, repairs, and depreciation in boiler and engine room.

3. General Expense

Plant General Expense

130 General Supervision:—Superintendent, general foreman, etc.

131 General Labor:—All miscellaneous labor which cannot be charged specifically to one of the manufacturing departments, such as: watchmen, janitors, and waste removal.

132 Miscellaneous Plant General Expense.

133 General Repairs:—Labor and material used for making repairs to buildings or equipment which cannot be charged specifically to one of the manufacturing departments.

134 Workmen's Compensation Insurance.

135 to 139 (Reserve for any special plant general expense accounts desired.)

Note — If more than one plant is operated, accounts 130 to 139 would be divided into 130-A and 130-B, etc., to refer to plants A and B.

Administrative Expense

140 Officers' Salaries.

141 Office Salaries: — Accounting, purchasing, engineering departments, clerks and stenographers.

142 Miscellaneous General Expense: —Office supplies, postage, telephone, telegraph, directors' fees, dues, subscriptions, legal expense, auditing expense, traveling expense except salesmen.

143 to 156 (Reserved for any analysis of miscellaneous general expense desired.)

157 Interest on Mortgages or Bank Loans.

158 Loss from Bad Debts.

Selling Expense

160 Salesmen's Salaries, Commissions, or Bonuses.

161 Salesmen's Traveling Expenses.

162 Sales Office Salaries:—Clerks or stenographers in sales department.

163 Miscellaneous Sales Expense:—Sales office expenses.

164 Advertising.

165 to 169 (Reserved for any analysis of selling expenses desired.)

GENERAL ACCOUNTS NOT INCLUDED IN FOUNDRY COSTS

Deductions From Sales

190 Defective Castings Returned.

191 Allowances.

192 Trucking, Freight and Express Out.

193 Cash Discounts Allowed Customers.

Revenue Accounts

Sales Accounts
200 Castings.
210 Patterns.
220 Japanning.
230 Machine Work and Assembling.

Other Income
250 Discounts Earned.
251 Interest Received.
252 Bad Debts Collected.

Asset Accounts

Current Assets
301 Petty Cash Fund.
302 Cash in Bank.
311 Accounts Receivable—Customers.
312 Accounts Receivable—Sundry.
315 Notes Receivable.
321 Inventory—Raw Materials.
322 Inventory—Finished Castings.

327 Inventory—Foundry Supplies.
331 Stocks and Bonds.

Fixed Assets

341 Land.
342 Buildings.
343 Machinery and Equipment.
344 Tools and Equipment.
347 Auto and Trucks.
348 Furniture and Fixtures.
349 Patterns.

Prepaid Expenses

361 Prepaid Insurance.
362 Prepaid Interest.
363 Customers Pattern Work.

Liability Accounts

Current Liabilities

411 Accounts Payable—Trade.
412 Accounts Payable—Sundry.
415 Notes Payable.
421 Accrued Payroll.
422 Accrued Interest.
423 Accrued Liability Insurance.
424 Accrued Taxes.
429 Dividends Payable.

Operating Reserves

442 Depreciation on Buildings.
443 Depreciation on Machinery.
444 Depreciation on Tools and Equipment.
447 Depreciation on Automobiles and Trucks.
448 Depreciation on Furniture and Fixtures.
449 Depreciation on Patterns.
455 Reserved for Bad Debts.
456 Federal Income Tax.

Capital Accounts

481 Capital Stock: Common.
482 Unissued Stock.
485 Capital Stock: Preferred.
486 Unissued Stock.
491 Capital Surplus.
492 Earned Surplus.
499 Profit and Loss Current Year.

This is the second of a series of three articles presenting the standard cost system prepared by the cost committee of the Gray Iron institute, Cleveland. The third installment will appear in the Feb. 15 issue.—THE EDITORS.

Locomotive Cylinders Have Changed

By Robert E. Masters

BIG league baseball scouts trailing through the dense underbrush in search of talented recruiting material are regarded as one of the outward symbols of modern, progressive business methods. Like many other more or less popular beliefs, this will bear little investigation. My memory extends back to the middle of the past century. The practice of selecting promising youths and grooming them for responsible positions in practically all lines of endeavor was in vogue in my early days. Contemporary history would seem to indicate that the same practice obtained even to the days when the mind of man runneth not to the contrary.

Back in the sixties I tramped the sidewalks of New York from east side to west side twice a day for three years while learning the art and science of founding at the locally famous plant of the John Roach Shipbuilding Co. Two weeks after completing my apprenticeship, a gentleman approached me with a proposition to take charge of making the locomotive cylinder castings for a railroad company. I accepted the position and was installed in 1869, two months before I attained my majority, without answering a questionnaire and lacking nearly everything usually included under the heading: Higher education. My school days were over when I left the twentieth ward grammar school No. 32 in 35th street to go to work at 10 years of age.

Sixty years ago locomotive cylinders were not the imposing castings they are today. The cylinder was a straight tube with a valve rest, port holes and flanges for the heads. A large cylinder weighed approximately 1 ton. Everything connected with the railroad was in a primitive state. All the engines were wood burners and the biggest and most noticeable feature on each one was the huge funnel shaped smoke stack.

As an illustration of the crude conditions prevailing, consider the site of the present Grand Central station of the New York Central railroad at 42nd street and Fourth avenue, New York city. At the time of which I write this location was occupied by an ordinary roundhouse where locomotives were groomed, repaired and made ready for the road. Freight trains came in to the yard near the round house and the little dinky cars were hauled one at a time by mules through the Fourth avenue tunnel to the downtown freight shed.

Horses Furnished Power

Freight car loads of cord wood were brought to the roundhouse for firing the locomotives. The regular 4-foot sticks were cut in two on a circular saw for which the motive power was furnished by two horses on a treadmill. Many a time while a boy have I watched them doing this work. This little two-horse power outfit cut all the wood for every locomotive running out of New York city on the New York Central & Hudson River railroad in the late fifties and early sixties of the past century.

Increases in size and weight and improvement in design followed each other rapidly. Coal, and later oil was adopted as fuel. As the smokestacks grew smaller, the cylinders and other component parts grew larger with many additions and attachments. In the nineties I made some 6000-pound cylinder castings for the Texas & Pacific railroad and shared the common opinion at that time, that these castings represented the approximate limit for locomotive cylinder development.

Later the immense mogul and mallet type engine was developed with an overall length of 125 feet and a total weight of 400 tons. In 1910 we filled a Southern Pacific railroad order for compound cylinders for this class of engines. Each casting with half the boiler saddle and other connections in place weighed 13,000 pounds. Henry Miller, president of the St. Louis Terminal railroads designed the chassis for a lot of locomotives which included both cylinders cast as a single unit that weighed 40,000 pounds.

A recent news item deals with a fleet of giant oil burning locomotives now under construction by the Canadian Pacific railroad for service in the Rocky Mountain territory. It is claimed these are the largest locomotives ever built in the British empire. One of the interesting features of construction is a single steel casting weighing 65,000 pounds and embracing the two cylinders, the under frame, the boiler saddles and the pilot bar. These steel castings were made at the plant of the Commonwealth Steel Co., Granite City, Ill., and illustrate in a graphic manner the evolution of the locomotive in a period of approximately 60 years.

L. E. Fries, for the past 12 years employed in the automotive parts field, has been appointed district sales manager of the U. S. Electrical Tool Co., Cincinnati, at Cincinnati. He succeeds R. H. Clore, recently appointed general sales manager of the company.

Art Bronze Is Cast in Chicago Foundry

Methods and Materials Used for Statuary Work Differ Considerably from Those in Vogue in Other Types of Shops

FIFTY years ago a young man was graduated from the University of Illinois and immediately went to Paris to spend four years studying art in an artistic environment under the great masters of the period. Before he left Urbana, Ill., he tossed an idea into the mills of the god. Mills, which according to a widely quoted poem, grind exceedingly small. In Longfellow's translation of Friedrich Von Logau's German, the original is amplified to some extent and the second line reads: "So soft and slow the great wheels go, they scarcely move at all."

The young man returned to his native land in 1883 and set up a studio in Chicago where he modeled a relief of the motto of the university—*Learning and Labor*—clasping hands. This idea also was thrown into the mills—to continue the similitude to the third line—"The souls of men fall into them and are powdered into dust." The powdering process was continued until 1916 when the young man, now recognized as the famous American Sculptor, Lorado Taft, again opened the mills to add another idea to the grist. This time he had a fairly definite idea in mind. He wanted to see a sculptural group retaining the original conception of Learning and Labor, erected on the campus of his Alma Mater. He made a sketch of the proposed group and experimented to some extent with the size of the figures to be included. Apparently the milling process was complete and nothing remained but to write the final line: "And from the dust spring sweet white flowers, Love, Hope, Trust." The dust in the mill produced the beautiful flowers of love and hope and trust in gratifying profusion, but unfortunately another kind of dust is required to translate these somewhat abstract items into heroic fiures of enduring bronze. A plaster cast of the proposed Alma Mater group was erected on the steps of the auditorium, June, 1922, in time for the fiftieth commencement.

Speaking at the alumni reunion on that occasion, Mr. Taft declared the modeling of the statuary group had been a labor of love, a period of happy toil, recalling the wonderful days of the early practice of his art. He had been going to his studio at 5 o'clock every morning returning to his home at 8 for breakfast, and these fragrant mornings brought back memories of similar dewy dawns of nearly 50 years ago when he used to hasten over to his spacious studio in the basement of old University hall and work in the clay until hunger proclaimed breakfast time.

In 1923 an alumni fund was created by the University of Illinois alumni association to induce universal annual giving by alumni, students and citizens in appreciation of the educational opportunities afforded and to encourage gifts of any size for the benefit of the university. An alumni fund board was appointed in 1924 and this board decided the first project to receive attention should be the Alma Mater group designed by Mr. Taft.

Mr. Taft donated the conception, the design, the models and all the time which he spent on the work over a period of many years. The alumni board raised the necessary funds for casting the figures in bronze and setting them up on a suitable foundation on the campus of the university in time for the annual commencement, June, 1929. The long discussed project constitutes a tribute to the university and a memorial to Lorado Taft now in his seventieth year. The idea of fifty years ago has been expanded and developed into the present group of heroic size, typifying his beloved Alma Mater with outstretched arms welcoming her children home. Immediately back of the central figure are two figures symbolizing Learning and Labor, the motto of the university. Learning is typified by the Lemnian Athena figure (with arms added to the statue, not in the original antique) who grasps Labor, a student in a leather apron, by the hand. A classical chair binds the group together. The group as it appeared, partly erected and assembled on the floor of the American Art Bronze Foundry, Chicago, is shown in Fig. 1. The third figure in college cap and gown, designed to stand a short distance in front of the chair

FIG. 1—PARTLY ASSEMBLED ALMA MATER GROUP DESIGNED FOR CAMPUS OF UNIVERSITY OF ILLINOIS. THE FIGURES TYPIFY THE MOTTO OF THE UNIVERSITY, LEARNING AND LABOR

is not shown. However, the bolt holes may be seen in the foundation flange for joining the third section in place.

The chair and each of the heroic size figures were cast in several sections for convenience in handling. After they were shaken out and cleaned the various sections were joined, either through internal flanges and bolts, or, through the so-called Roman joint and rivets. The parting line in each instance was designed cunningly to help the illusion that the entire assembly is a one-piece casting. The various joints are hammered over, scraped and filed so that it is practically impossible even for one accustomed to the work, to find a joint.

Several methods are available for making castings of this description. At the plant of the American Art Bronze Foundry, Chicago, presided over by the veteran Jules Berchem who learned his trade in Paris, the castings are molded in French sand from full plaster patterns. The plaster patterns in turn are made from the sculptor's original clay model and come to the foundry properly parted and jointed to facilitate assembly of the various parts of the casting. The foundryman's work commences with the receipt of the patterns and his object is to produce metal duplicates with the desired contours.

Cores Are Shaved

The principal feature on which this style of molding differs from that usually practiced, is the method of securing the metal thickness. Manifestly the problem of producing a corebox that would yield a core to follow the outline of such an irregular pattern is outside the realm of practical shop operation. As in many other seemingly impossible situations, a simple method has been devised to make the core and to insure a uniform thickness of metal throughout the casting.

Briefly, the core is rammed inside the mold after the pattern has been removed. The core then is lifted out and a thickness of sand corresponding to the desired metal thickness of the casting, is shaved off. Core and mold then are dried, assembled and set up on the floor where the metal is poured into the mold through a number of small gates connected to a basin designed to hold sufficient metal to fill the mold. This method of pouring is employed universally in all statuary foundries. The amount of metal is calculated in advance and in that way the basin is emptied by the time the mold is filled. Where a doubt exists, one or more risers are provided and the extra metal is *flowed through* these risers instead of remaining in the pouring basin to freeze into a large, unwieldy lump of metal.

Collecting the metal in a pouring basin presents many advantages. Where the metal is melted in two or more furnaces, the act of dumping it all in one pouring basin equalizes the temperature and composition. The dross, if any, is kept floating on the top and only clean metal enters the gates. The height of the basin imparts speed and pressure to the stream, desirable features where a comparatively large quantity of metal has to be spread thin over an area of considerable extent.

Jules Berchem
1856-1930

JULES BERCHEM, famous statuary molder and founder of the American Art Bronze Foundry Chicago, in which the Alma Mater group for the University of Illinois and many other noted artistic castings were made, died Jan. 6 at the age of 73. By a rather curious coincidence THE FOUNDRY *published a biographical sketch of the late Mr. Berchem in the Jan.* 15,. 1930, *issue in which tribute was paid to his outstanding ability in his chosen field, the production of statuary and other artistic objects in bronze and other nonferrous metals. He was born in Paris, France Dec.* 9, 1856 *and at the early age of nine was apprenticed to the art which he followed thereafter throughout his lifetime with credit and distinction. He came to the United States in* 1885 *and in* 1886 *he opened his first art foundry in Chicago.*

An adaptation of the same general idea is applied in pouring tablets. The mold is made in a horizontal position in the usual manner and either skin dried or dried in the oven. Afterward it is assembled and turned up on edge. The metal is poured into it while in that position. Hard sand and rigid clamps are required to prevent the mold from straining under such severe service.

In some instances the method of making the mold and core for a statue is varied to the extent that the core is not removed from the mold. French molding sand is employed for the inside and the outside of the casting. This particular grade of sand comes from a vein near Paris and so far as known is the only sand of its kind in the world. Other veins may be in existence but up to the present they have remained undiscovered. This sand presents in itself, two characteristics usually considered contradictory. In foundry parlance it is *tight* and *open* at the same time. It may be rammed as hard as a brick and it will retain its extreme porosity. The molds are made in iron or steel flasks, bolted together in sections and provided with only one or two bars or bolts. The sand is so tenacious and is rammed so hard that the bars and gaggers usually associated with ordinary sand and ordinary foundry practice are not required.

Minor modifications are introduced in practically every mold, but in general the procedure is as follows: The drag is placed on the floor joint side up and the pattern is blocked up in approximately the correct position. Heap sand is rammed in the flask around the pattern and a joint is made according to the judgment of the molder. Small or large bodies of prepared sand are rammed into each pocket, undercut or over hanging part of the pattern and smoothed off to present a surface from which the cope may be lifted. Each of these small bodies of sand is provided with a hook by which it may be attached to the cope later.

Drag Forms Follow Board

The various runners are arranged leading to a central main runner. The cope part of the flask then is set in place on the drag and rammed full of sand. Both parts then are rolled over. The drag which served merely as a follow board is shaken out. The drag face of the pattern is served in a similar manner to that of the cope, in the event that it presents a surface broken by undercuts and back drafted areas. Then the drag is rammed full of sand and lifted off. The loose pieces of sand are removed from the pattern and fastened in place on drag face of the mold. The pattern then is removed from the cope and the loose pieces of sand are attached to the cope face by the hooks.

With the cope and drag lying open, the molder fashions an arbor for the core and fits it in the cope half of the mold. This arbor is made up of a number of pieces of steel rod, bent to the necessary shape and bound together with strands of wire. Sand is rammed around the arbor and into the entire cope cavity. Then the drag is placed on the cope and the remainder of the cavity is rammed full of sand to form the complete core.

The drag is lifted off again to ex-

FIG. 2—BRONZE FIGURE OF BENJAMIN FRANKLIN PRESENTED BY JOSEPH MEDILL TO THE PRINTERS OF CHICAGO. SEATED—JULES BERCHEM

pose the core. The molder goes over the core carefully and removes the necessary amount of sand to correspond to the thickness of metal required in the casting. The drag then is replaced and the entire assembly is rolled over. The cope then is lifted off and the molder repeats the process of removing the sand thickness from the half of the core thus exposed. Wisps of cotton waste or strips of wax inserted at the joint before the flask is rolled over, prevent loose sand from falling into the drag cavity while the molder is cutting the sand from the cope half of the core.

Molds and cores are dried in a large coke fired oven served by a car operating on a track that extends out on the molding floor. The floor is spanned by a 10-ton traveling crane operated by hand chains. This crane has all the desirable characteristics of the best traveling crane except speed, and speed is not a factor of much importance in a shop where jobs remain in the sand for weeks at a time and only require the service of a crane once or twice during such an extended period.

Metal is melted in a battery of coke fired pit crucible furnaces equipped with forced draft. Special compositions are melted for special castings, but the statuary castings are poured from a composition known as United States standard bronze, 90 per cent copper, 5 per cent tin and 5 per cent zinc. Eight ounces of lead are added to each 100 pounds of metal. The foundry occupies a space of 3200 square feet and normally employs a dozen highly skilled molders.

New Officers Installed

William McPherson, dean, graduate school, Ohio State University, Columbus, O., became president of the American Chemical society on Jan. 1. He succeeds Dr. Irving Langmuir, associate director of research, General Electric Co., Schenectady, N. Y. In accord with a recent change in its constitution, the society now elects a president and a president-elect who serve in successive years. Moses Gomberg, professor of chemistry, University of Michigan was chosen president for the year 1931 under the new rule.

Prof. James F. Norris, Massachusetts Institute of Technology, Boston, and Charles L. Reese, E. I. du Pont de Nemours & Co., Wilmington, Del., were elected directors for 1930-1932. The following councillors-at-large were named: Edward Bartow, professor of chemistry, Iowa State university; Prof. S. C. Lind, director, school of chemistry, University of Minnesota; Hugh S. Taylor, professor of Physical chemistry, Princeton university; David Wesson, consultant, Montclair, N. J.

Issues Tool Catalog

Cleveland Pneumatic Tool Co., Cleveland, has issued a 106-page catalog of the pneumatic tools that it manufactures. The booklet describes the details of construction and explains the advantages with sectional views. The fore part of the booklet is devoted to description and data on riveters. The second section deals with chipping hammers and tools used in mining operations. The third part describes foundry rammers. The next division is devoted to pneumatic drills and the fifth section explains its line of grinders. The last part of the catalog is devoted to accessories. The catalog is illustrated with halftone reproductions of the various machines and typical installations. Tables of data which give the specifications and dimensions accompany the illustrations.

Ohio Founders To Meet

The next sectional meeting of the Ohio Foundries association, Inc., will be held at Dayton, O., Feb. 6. An interesting program has been arranged during which the following papers will be presented: "Material Handling in Small Foundries," by W. B. Marshall, Chain Belt Co., Milwaukee; "Advances in Nonferrous Foundry Practice," by A. A. Grubb, metallurgical engineer, Columbus, O.; "The Ohio Foundry Code," by A. H. Kramer, president, Advance Foundry Co., Dayton, O.

FIG. 3—HEAD AND TORSO OF FRANKLIN STATUE LEAVING THE MOLD IN WHICH IT WAS CAST. LARGE FIGURES USUALLY ARE CAST IN SEVERAL SECTIONS AND AFTERWARD ASSEMBLED

Questions & Answers on FOUNDRY PRACTICE

GRAY IRON

Specify Floor Plates

QUESTION

Kindly suggest a suitable analysis for cast iron wharf plates and skirt boards for a coke plant. These plates must have a tensile strength to support 160 pounds per square foot and in addition must have the ability to withstand alternate heating and cooling. The coke from the ovens is dumped on these plates and then deluged with cold water.

ANSWER

Castings to which you refer belong to that wide classification which may be poured from almost any kind of gray iron and still serve satisfactorily. Assuming that the plates are 3 to 4 feet square, ¾ to 1-inch thick, ribbed on one side, an approximate analysis would show: Silicon 2.20 per cent, sulphur 0.06 per cent, phosphorus 0.30 per cent and manganese 0.60 per cent. When it is realized that the average breaking load on a 12-inch bar is 2000 pounds, the problem of producing a plate that will support 100 pounds per square foot loses practically all significance. It is merely one of the supernumerary clauses with which engineers and lawyers clutter up briefs and specifications.

The same objection may be introduced to an attempt to stress the severe service to which the plates are subjected, due to alternate heating and cooling. As a matter of fact the plates in front of any given oven only receive the hot coke at intervals that may range from 16 to 48 hours, depending on the type of oven and the details of the process. The very essence of coke making is to quench the coke immediately after all the volatile elements have been extracted and before combustion takes place in the open air. The hot coke is flooded with water the instant it has been pushed from the oven and before the deck plates have been raised to any considerable temperature. Briefly, to reduce the problem to a practical basis, you can pour the castings from a mixture of one-third pig iron and two-thirds scrap, either foreign or domestic.

If the plates are ribbed, particular attention will have to be paid to the molding. Poorly made molds, wet or hard sand in the corners will produce blowholes, draws and segregation. Castings of this kind easily break in service and the blame is placed on the iron when really the accident is due to the manner in which the mold was prepared.

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall—Cast Steel
H. A. Schwartz—Malleable Cast Iron
J. W. Bolton—Gray Cast Iron

All questions should be addressed to The Editor, The Foundry, Penton Building, Cleveland.

Q & A

Blast Causes Hardness

QUESTION

In polishing our castings we have to use an emery wheel for the first operation instead of rough emery on a polishing wheel, due to the hard scale. We are at a loss to account for this hard skin on the castings unless it is due to our practice of wetting down the floors of molds before they are dumped, say about half an hour after they are poured. We use the best grade of pig iron mixed only with our own return scrap. For example the heat for two recent days was made up of 3700 pounds pig iron of the following analysis: Silicon 3.00 per cent, sulphur 0.03 per cent, phosphorus 0.60 per cent, manganese 0.70 per cent; 3600 pounds of a second pig iron with silicon 2.88 per cent, sulphur 0.02 per cent, phosphorus 0.55 per cent, manganese 0.73 per cent; 6300 pounds sprues; no returns. On the second day the same items were employed to the following extent: No. 1, 4600 pounds, No. 2, 4500 pounds, No. 3, 6700 pounds, No. 4, 800 pounds. We are running light now on account of the slack season.

ANSWER

From the data submitted we are satisfied the hard scale on your castings is caused neither by the composition of the iron nor the practice of wetting the sand. Light castings remaining in the sand for half an hour have cooled beyond a point where they can be affected by a dash of water. The next logical place to look for the cause of the trouble, is in the cupola. Since you have given no particulars on this device we are at a loss to offer a definite opinion. The most probable cause of the hard scale on the castings is a high blast in the cupola. On account of the slack conditions prevailing, your daily heats have been reduced to an average of 15,000 pounds. From this we infer that your regular daily heat probably is in the vicinity of 30,000 pounds. The cupola usually employed in a foundry pouring 30,000 to 40,000 pounds of metal daily is lined to 48 inches and the blast pressure is held to 10 to 12 ounces. On short heats such as you now are running, 8 to 10 ounces is sufficient and even then the blower should be throttled down still further toward the close of the heat. Your metal reports No. 1 and No. 2 leave too much to the imagination. For No. 1 your figures read: Pig iron (a) 3700 pounds, pig iron (b) 3600 pounds, sprue 6300 pounds, returns *none*. In No. 2 the charge was made up of pig iron (a) 4600 pounds, pig iron (b) 4500 pounds, sprues 6700 pounds, returns 800 pounds.

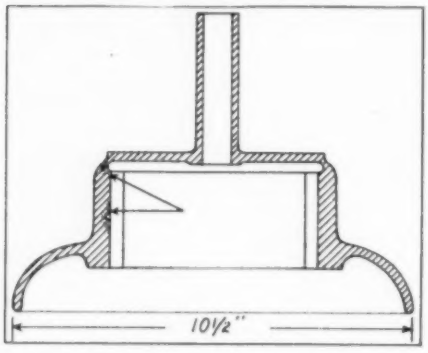
Of course we cannot say where the 6300 pounds of sprue came from in No. 1, but certainly 6700 pounds of sprue listed in No. 2 did not come from a heat of 13,700 pounds on the preceding day. It is out of all reason. Also the item *no return* in the first instance. There never was and probably never will be a light work foundry able to turn in a report like that.

Q & A

Causes Dirty Castings

QUESTION

Under separate cover we are forwarding for your examination a small casting in which the teeth are cut for an internal gear as shown in the accompanying sketch. These castings apparently are perfect until the machining operation discloses one or more defective spots at one



DIRT IN VARYING QUANTITIES IS ARRESTED BY CONTACT WITH THE VERTICAL WALLS OF THE MOLD

of the two points indicated by the arrows.

ANSWER

The defective spots in the casting are caused by a combination of dirt and shrinkage. Under ordinary conditions and with the iron you are using the casting would shrink normally and would show no segregation in the comparatively heavy band in which the teeth are cut later. However, where a small quantity of dirt lodges at the points indicated by the arrows the dirt forms a cavity and in addition prevents the iron in the vicinity from shrinking normally. The result is that the cavity formed by the dirt is accentuated. The casting submitted for examination has been ground and machined and therefore we cannot say specifically whether the dirt is washed in from a dirty gate or is owing to parts of the face of the mold that became detached.

The remedy for the condition obviously is to provide a perfectly clean mold in which the sand is tempered, rammed and vented properly to prevent the slightest *boiling* while the iron is filling the mold. A perfectly clean and firm gate is required for the same reason and of course the iron must be skimmed to prevent the entry of any small particles of slag. The style of gate employed is immaterial provided it conforms to the foregoing requirements. We suggest a set-gate at the joint with three branches 2 inches wide and ⅛-inch deep. This gate to be served by a single upright runner 1-inch diameter. As a further precaution it may be advisable to place a strainer core either in a basin at the top of the runner or in a pocket at the bottom where the runner joins the gate. From the general appearance of the face of the casting we are inclined to the belief that you are working your sand too wet.

GENERAL

Lid Castings Crack

QUESTION

We are attaching for your observation a marked blueprint of a water wheel cover 6 feet 7 inches outside diameter ranging in thickness from 25/32-inch at the rim to 2 inches on the ring which surrounds the 15-inch opening in the center. This casting cracked at two points on the rim before it left the foundry. The casting was poured from a half and half mixture of pig iron and heavy machinery scrap. What caused the casting to crack?

ANSWER

The cracked rim resulted from uneven contraction and uneven contraction was due to several factors including the shape of the casting, the position of the gates and the manner in which the casting was stripped. The rim of the casting as shown in the drawing is thinner than any other part. This feature coupled with the probable position of the gates in the center caused the rim to cool first. Later the center began to contract and naturally the pull on the rim caused the rim to crack. Even if the casting was left covered in the mold until it cooled off, the contraction would not be uniform on account of the central gates and the uneven thickness of metal. In all probability the cope was removed shortly after the casting was poured and that accentuated the trouble.

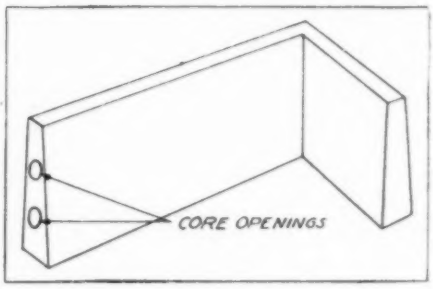
To boil the whole thing down to its fundamentals familiar to practically every jobbing foundryman, the casting cracked for the same reason that pulleys crack, or for the reason that any wheel of the same general design will crack if the contraction strain is not equalized by stripping the hub and digging out the core. Under ordinary conditions this particular water wheel cover might not crack, but certainly it would contain hidden strains and stresses. A small additional hazard, a cold draft on the exposed rim, might be sufficient to crack it. To be on the safe side the casting should be allowed to remain covered in the mold until it is cold. The center should be stripped shortly after the casting is poured.

Q & A

Water Front Leak

QUESTION

We are having considerable trouble with the L-type water back for coal and wood burning stoves. Cores and molds apparently are up to the usual standard, but the castings leak under test. At first the cores were made from a mixture of 4 parts sharp sand, 1 part red molding sand bonded with a water soluble binder. Later the mixture was changed to 6 parts sharp sand, 1 part No. 1 Albany sand bonded with oil. The vents were made with ⅛-inch rods with ⅜-inch vent wax at the bend of the core. After



ALL THE GAS PASSES THROUGH TWO SMALL OPENINGS IN ONE END

the cores were dried we stopped the vent holes in the blank end with pinches of core sand and placed the cores again in the oven for a thorough drying. The cores are held in the mold by the prints at one end and by anchors in the cope and drag. The castings are poured from iron melted quite hot and made up of the following ingredients: Pig iron, 40 per cent; motor blocks 45 per cent and steel scrap 15 per cent.

ANSWER

In addition to the vent rods, the cores for these exacting castings must be made from an open sharp sand bonded with a minimum amount of binder to insure the greatest possible permeability. The casting is so thin and fills so rapidly that an immense volume of gas is liberated and provision must be made for its rapid escape through the two small vents in one end of the casting. Addition of molding sand to the core mixture decreases the permeability and an excess amount of binder does the same thing. Omit the molding sand from your mixture, cut down on the amount of binder and dry the cores almost to the burning point and you should have no further trouble. You did not state what kind of chaplets you are using, but we assume you are using the regular type supplied by foundry supply houses. A possibility

exists that you may be employing a crude type of chaplet on which a slight film of rust or dampness causes the metal to boil in the vicinity. Needless to say the greatest care is required in removing every factor from this mold that might cause the slightest disturbance while the metal is in the liquid condition.

Q & A

Need High Temperatures

QUESTION

Have you any data on the pouring temperatures of gray iron, particularly of high test cast iron? What temperatures are being used in pouring machinery castings and how much higher will it be when high test irons are used? Is any trouble encountered with cupola linings due to high temperatures employed?

ANSWER

To obtain the soundest castings, all iron should be poured at not less than 2400 degrees Fahr. At present too many machinery castings are poured from 2250 to 2300 degrees Fahr. These low temperatures tend toward shrinks and promotes openness. High test cast iron should be poured at 2450 degrees Fahr. or a little above to counteract the greater shrinkage of the lower total carbon metal. If your lining is done with the proper materials, you should have no difficulty. See that you have a highly siliceous daubing material for patching. A mixture of 1 part refractory fireclay and 1½ to 2 parts refractory silica sand mixed to the consistency of a stiff mud has been recommended. Information of value to you in operating the cupola may be found in a series of articles by John W. Bolton which appeared in the April 15, May 1 and May 15, 1928 issues of THE FOUNDRY.

MALLEABLE

Makes Cupola Malleable

QUESTION

Please give me the general practice in melting cupola malleable iron. Specifically, I wish a mixture; the probable percentage of loss of silicon and manganese; the general ratio of coke to iron and the chances of difficulty with the iron when using cupola malleable (hard iron) sprue in the charge. I also would like to know the tensile strength and the percentage of elongation for cupola malleable.

ANSWER

A typical charge of cupola malleable will consist of 40 per cent sprues, 20 per cent malleable scrap, 20 per cent malleable bessemer pig iron, 20 per cent steel and about 15 to 30 pounds of spiegel to raise the manganese to between 0.55 and 0.65 per cent. Melting loss in silicon averages around 0.10 to 0.15 per cent; manganese from 0.15 to 0.25 per cent; phosphorus remains the same and sulphur will increase from 0.06 to 0.12 per cent. The usual ratio of iron to coke is 6 to 1.

You should have no difficulty with using hard iron sprue as you can see from the suggested mixture that 40 per cent of this material generally is used. Trouble may result if the percentage of annealed malleable scrap is too high. If you see that correct melting practice is observed your malleable should have a tensile strength around 40,000 pounds per square inch and an elongation from 6 to 10 per cent in 2 inches. In melting cupola malleable, the tendency is to use smaller charges than in gray iron to obtain faster melting and hotter metal. However, you probably will find that observing the rules for melting gray iron will give good results in melting cupola malleable.

Q & A

Data on Pipe Fittings

QUESTION

Kindly advise me what is considered the best type of iron obtainable for making malleable pipe fittings ranging from ½-inch up to 6 inches, and advise the analysis. Can you tell me just what is the chemical action or change that takes place during the process of annealing?

ANSWER

Pipe fittings generally are made from cupola white iron which will contain about 3 per cent or a little over in carbon. Silicon must be controlled to give castings with a white fracture. This element probably will be higher in the small castings than in the large. The total range may be from 0.60 to 1.10 per cent. Sulphur in cupola metal usually is higher than in air furnace metal and may reach 0.10 to 0.12 per cent or even more. Manganese on such work usually is about 2½ to 3 times the sulphur percentage.

The essential reaction in annealing hard iron is the conversion of cementite into nodules of carbon. The cementite dissolves and forms a solid solution. The carbon migrates from the surface of contact of cementite and solid solution and at some stage the chemical forces holding the elements together in iron carbide (Fe_3C) are broken. Free carbon then crystallizes out of solid solution.

At or near the surface a removal of carbon due to the combination of oxygen of the air or packing material takes place. The carbon of the metal and the oxygen forms a mixture of carbon monoxide and carbon dioxide whose composition depends upon the existing temperature and pressure. The iron remains in the free state or in extreme cases is oxidized to FeO or further.

STEEL

Steel Foundry Sand

QUESTION

Practically all the silica sand used in steel foundries on the Pacific coast comes from the central west. Sometimes a car of sand arrives which we cannot use. Has any standard been adopted by steel foundrymen covering the chemical and physical composition of crude silica sand for use in the steel foundry? If any such standard has been established I should like the information for a guide in ordering future shipments.

ANSWER

So far as we know there are no general specifications used by steel founders in purchasing the molding sand they require. The majority of foundries purchase a certain grade of sand under a certain trade name which indicates the source of the sand. This method has been found to be fairly satisfactory, since experience readily convinces the foundryman that a certain sand from a recognized sand producer meets all the requirements in his foundry. Occasionally a foundryman insists on the analysis and sometimes he insists that the sand meet a definite screen test, but these are the exceptions. The majority of foundrymen have learned through experience, that the sand producer is exceedingly jealous of his reputation and will supply only material that will give satisfaction. Practically all foundrymen insist upon a uniformity of grain size and this requirement is met by the producers screening and washing all their sand before it is shipped. The sand to which you refer as having proved unsatisfactory probably is a bank run material which has not been washed, dried or screened.

Q & A

Sand Causes Pinholes

QUESTION

We are forwarding to you a small steel gland casting with which we are having trouble. This was cast in dry sand and fed with a gate. What causes the small pinholes which show up, especially after the castings have been annealed?

ANSWER

It appears to us that the pinholes exhibited by the casting are caused by sand and mold conditions and not by any difficulty with the steel. However, before suggesting a better method of molding, we will have to know which side of the casting was up in the sand, and whether a sink head was used.

Problems in Nonferrous Founding

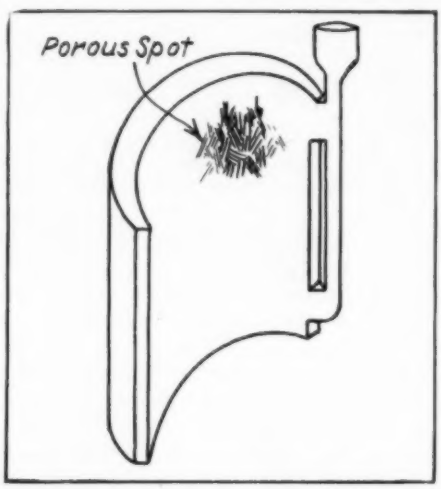
By Charles Vickers

Shrink Causes Porosity

We are making locomotive driving brasses weighing from 145 *pounds to* 360 *pounds each, the maximum thickness being* 3½ *inches. The alloy used is composed of* 75-80 *per cent copper;* 10-14 *per cent lead;* 8-10 *per cent tin, and* 3 *per cent maximum of zinc. We experience trouble due to sponginess appearing in the top center of these castings which are cast upright in green sand, as shown in the illustration. The castings are poured through gate and runner cores and no facing or blacking is used on the molds, though the cores are blacked. We have tried various pouring temperatures, ranging from* 1850 *degrees Fahr., to* 2100 *degrees at mold side. The latter temperature gives us castings free from porosity or sponginess but pouring at such a high temperature burns the sand into the castings, causing difficulty in machining. Also the metal apparently is too hard, having a brinell hardness from* 62 *to* 85. *The same metal can be used for any other type of sand or chill castings and will give good results. We melt in open flame oil burning furnaces, and we use borax and phosphor copper as fluxing agents. The latter is added to the metal in the furnace just before pouring into the ladles. Sand is used to slag the metal. Can you set us right as to the cause of the spongy difficulty?*

The porous spot is caused by the natural shrinkage of the metal in the mold. The upper part of the casting feeds the lower part with eutectic which seeps downwards between the formed crystals when the metal is partly solidified. The top center is the place where the metal is liquid the longest. The eutectic is that portion of the alloy that stays liquid the longest, because it is richer in tin than the rest of the alloy, and in obedience to the law of liquids drains into the lower voids leaving crystals of the faster freezing compounds in the space that formerly was occupied by the eutectic.

It is well known to practical men that pouring the metal hot will prevent such trouble entirely as the metal feeds more perfectly from the gates, sprues or risers. On the other hand hot-poured metal, especially when phosphorized eats into the sand more or less, and brings on other troubles such as those mentioned. The easiest way out of such difficulties is pouring hot, in the case of molds that can be plumbagoed completely, and where the molds can be opened up after the castings reach a low, red heat. The castings are hauled



POROUS SPOT APPEARS IN INDICATED PLACE ON THE CASTING

out, and gates are knocked off. A few moments spent with a common spade scrubbing them will leave the castings with little finishing to be done after they get cold. This method is practiced extensively in making mill bearings, which due to their shape have to be molded horizontally, with the entire mold accessible for plumbagoing.

In the case of driving brasses the pattern can be and often is made so the pattern can be drawn out endwise, leaving a narrow deep mold impossible to plumbago adequately. If these molds are poured hot, the castings are rough, and if poured cool, they have the *copper spot.* With metal at 1850 degrees Fahr., cooling proceeds so rapidly it is not easy for a riser to feed metal to fill up the spongy area. One way in which the copper spot can be avoided is to place a riser on the end of the bearing immediately above where the porous spot appears. This riser should be bushed up several inches above the top of the cope, and should be filled up a little later, about the time the top of the sprue has solidified, so the metal will not back out. Have a man with a hand ladle follow up the pourer, and add hot metal before the metal in the riser sets. Such risers can be made in dry sand cores which are set on the pattern and molded in with the cope making sure that they extend high enough to give the necessary head of metal.

Some makers of such brasses chill the bearing by simply placing a heavy cast iron chill in contact with the bottom of the bearing. It is necesary to see that this chill does not cause blowing of the metal. The use of risers as outlined increases molding cost by reducing production to some extent.

However, if the feeding is carried out successfully, it should produce smoother castings and lower cleaning costs, and better machining qualities are obtained. Machining costs in the case of hot-poured castings may be reduced by sandblasting the castings thoroughly, and by a reduction of the phosphorus content to correspond to an addition of 0.25 per cent of a 15 per cent phosphor-copper.

With high phosphorus, as often is specified in the case of high tin—high lead bearing alloys, a migration of phosphide to the outer skin of the casting occurs which will displace the lead at such surfaces. The machinist then at the start of his work will meet with this hard phosphide which will dull his tools rapidly as the piece is machined.

It will be noted that a decision has to be made between cool pouring and hot pouring. Whichever process is decided upon, the precautions necessary to getting sound castings will have to be taken into account. With the cool metal, the subject of how to feed the castings properly has to receive serious attention. With hot pouring it may be necessary to lower the phosphorus content of the alloy, and to use facing against the pattern.

The FOUNDRY Family Photograph Album

Upper Left

J. L. MURRAY

Grand Rapids Brass Co., Grand Rapids, Mich.

Upper Right

J. C. TAYLOR JR.

Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

Lower Left

B. G. PARKER

Youngstown Foundry & Machine Co., Youngstown, O.

Lower Right

W. J. WARK

E. J. Woodison Co., Buffalo

HINTS FOR THE COREROOM

(*Continued from Data Sheet No.* 798)

place where ordinary molasses can be used and because of its greater bond strength it may replace it to some extent.

Sulphite Liquors and Residues:

Specific gravity: Approximately 1.25; Average weight per gallon 10.5 pounds.

Composition: This is a waste residue from the manufacture of paper pulp. It is composed largely of resinous compounds but certain other constituents present render it a moisture drawing bond.

Mixing instructions: Binders of this type are most effective with burnt core sand and sand containing considerable clay. It may be added full strength to sand with about 3 to 5 per cent moisture and mixed thoroughly from 4 to 6 minutes in a mechanical mixer. These binders are often dissolved in water, in the ratio of 1 part of binder to 8 parts water, and used similarly to molasses water.

Baking conditions: The recommended baking temperature is 350 degrees Fahr. This type of binder has a tendency to migrate to the surface of a core during baking thus producing a core with a hard surface and a soft interior. This may be prevented to a considerable extent by having clay present in the mixture.

Use: Its use is confined almost entirely to used sand mixtures. It is used quite extensively in steel, malleable, and heavy gray iron. It should not be used with all new silica sand and is seldom used alone as a binder. It is most effective when used along with other dry binders and a large proportion of old or used sand. Sulphite liquors and residues draw moisture quite readily and care must be taken with the cores to keep them dry. It is best to use the cores as soon as they can be handled after baking and they should not stand in the mold long before pouring.

Core Mixtures:

All old sand mixture.

70 parts of old sand
1 parts of sulphite liquor
0.7 part of good grade of core oil
12½ per cent water for tempering
Bake at 400 degrees Fahr.

Pitches and Gums

Pitch Core Compound:

Specific gravity: Approximately 0.46; Average weight per gallon 3.9 pounds.

Composition: A mixture of a coal tar pitch and some adulterant usually dextrine. Pitch sometimes is used alone but because of its coking property

(*Continued on Data Sheet No.* 800)

HINTS FOR THE COREROOM

(*Continued from Data Sheet No.* 799)

and the resulting difficulty in removing the core from the casting it usually is mixed with some such binder as dextrine which counteracts this coking property to some extent.

Mixing instructions: Add binder to sand and mix thoroughly for about 3 minutes, add about 7 per cent tempering water and continue mixing 3 to 5 minutes longer. Binder, sand, and water should be measured carefully and mixing done in a mechanical mixer.

Baking conditions: The recommended baking temperature is from 350 to 400 degrees Fahr. Pitch binders dry rapidly and are not easily overbaked. This is of particular advantage for large cores. Prolonged baking and excessive bond may result in a dense hard core which may cause a boiling of the metal during pouring.

Use: Pitch binder is indispensable as a binder for large cores. Pitch is the most resistant to moisture absorption of any of the known bonds. It also can be used effectively with an impure sand, old burnt sand, and gangway sand. Because of its resistance to moisture absorption it is especially adaptable to large cores and in large molds where the cores must stand a considerable time before pouring. To produce a smooth surface along with a collapsible core, medium and large cores often are faced with oil sand and backed with pitch sand.

Core Mixtures:

Miscellaneous cores for gray iron
12 parts clean open silica sand.
12 parts old sand.
1 part pitch core compound.

Backing sand for large cores
45 parts old sand.
1 part pitch core compound.

Runner cup cores
15 parts old sand.
1 part pitch core compound.

Cover cores, slab cores, etc.
7 parts open clean new silica sand.
7 parts old sand.
1 part pitch core compound.

Rosin:

Specific gravity: Approximately 1.07; Average weight per gallon 9 pounds.

Composition: A product derived from the destructive distillation of wood.

(*Continued on Data Sheet No.* 801)

THE FOUNDRY DATA SHEET, FEB. 1, 1930
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Uniform Methods of Analysis

Should Govern

Core Oil Specifications

By V. A. Crosby and R. D. Wysong

UNTIL Campbell's research work presented before American Foundrymen's association in 1925, core oils had received little consideration. The old method of investigation was to eliminate various types of core oils by checking working conditions of the sands and rigidity of cores produced after baking. This method usually worked admirably for some particular oil. It must not be concluded that this is a deplorable situation because foundries have and are prospering under this plan. However, there are two disadvantages which arise when that method is used, namely, the elimination of competition and the sudden cancellation of contracts and the return of core oils to dealers because of core room trouble.

These conditions actually may exist when the dealer is supplying exactly the same oil. The reason of the failure is difficult to discover when there are no specifications or analyses. The opposite of the above condition would be an intelligent specification which would render to all the privilege of quoting prices and at the same time protect them against sudden outbursts of the foundry management in time of trouble.

The authors presented a paper at the 1927 convention of the American Foundrymen's association which outlined a plan by which a fair degree of accuracy could be obtained relative to the uniformity of core oils. The plan has been in force at the Studebaker Corp., South Bend, Ind., and its success has been due to standardized chemical methods as used on pure linseed oil. The specification shown in table II, represents the grade of oil used at that plant for the past three years.

A number of inquiries have been received relative to the methods for chemical analysis from plants where a specification is anticipated. Certain oils also have been checked upon request to verify analyses given by the dealer. In some cases results have been gratifying while in others they have been discouraging.

It was recognized some time ago that if analytical methods were to become successful, some recognized standard method of procedure must be followed and so stated in the specification. There are three standard methods for the determination of iodine numbers—Hanus, Hubl and Wijs.

The Wijs method appears to be in best repute and is used by the authors for all iodine determinations. However, there are certain core and linseed oil companies that still use the Hanus method. It is a recognized fact that these two methods do not give like results on the same oil. However, there is a correction that can be applied when the particular meth-

Analyzes Core Oils

CONSIDERABLE discussion has developed at recent A. F. A. conventions on the subject of specifications for core oils. Several companies have specified certain conditions which govern the purchase of oils. These specifications, which are based on results obtained in the core department, permit the core oil to be checked by chemical analysis and accepted or rejected on that basis. In this article, which is abstracted from a paper presented at the Chicago convention of the American Foundrymen's association, the authors have described the methods of analysis and the specifications in force at the plant of the Studebaker Corp., South Bend, Ind. V. A. Crosby is metallurgist and R. D. Wysong is chemical engineer at that plant.

Table I

Iodine Numbers of Core Oils and Their Constituents

(By Wijs Method)

Time	No. 1* Oil, actual	No. 1 Oil, computed	Difference	No. 2* Oil	Raw Linseed	"F" Gum Rosin	"F" Wood Rosin	Kerosene
15 min.	149.24	146.51	2.73	146.60	183.96	170.20	170.00	10.65
1 hr.	157.38	148.74	8.64	153.34	183.00	180.26	173.26	11.75
2 hrs.	166.09	152.04	14.05	158.63	.....	192.43	182.36	16.06
3 hrs.	166.83	153.08	13.75	162.40	.....	200.10	193.20	18.59
4 hrs.	168.10	154.58	13.52	163.96	.....	202.40	200.86	18.80
5 hrs.	168.40	155.41	12.99	164.59	184.21	206.26	203.93	19.11
10 hrs.	168.88	156.16	12.72	167.65	.....	207.76	207.00	21.38
15 hrs.	178.16	158.67	19.49	170.94	.....	219.76	210.76	21.90
25 hrs.	194.30	162.84	31.46	191.27	184.43	237.88	230.28	24.64
50 hrs.	211.93	.....	.....	206.13	.....	254.60	246.24	28.00
100 hrs.	220.59	.....	.....	216.91	.....	256.30	247.00	.....

*No. 1 Oil = 60 per cent by weight, raw linseed; 20 per cent by weight "F" gum rosin; 20 per cent by weight kerosene. *No. 2 Oil = 60 per cent by weight, raw linseed; 20 per cent by weight, "F" wood rosin; 20 per cent by weight, kerosene.

od used is specified. The other chemical determinations in a satisfactory core oil specification are standard and do not lend themselves to much variation in the hands of competent chemists.

Iodine numbers, as effected by absorption time of solution and obtained by the Wijs method, are shown in table I. It is evident that iodine numbers mean practically nothing unless the time of absorption of the oil in the iodine solution is specifically stated. This refers to oils carrying a percentage of rosin. Linseed is not affected by time as indicated in the table.

The progressive absorption of rosin from Wijs solution is mentioned by Lewkowitsch, *Chemical Technology*, vol. I, p.496. With the complete solution of rosin in mineral and linseed oil, it was expected that the progressive increase would be eliminated due to the more perfect dispersion of the rosin in solution.

The specifications of table II represent one of a possible one hundred kinds of core oils possible to make. The foundryman must specify certain conditions and maintain them until additional research indicates something better. The specification then should be rewritten.

There exists an abnormal increase in iodine number with increased time absorption on core oil Nos. 1 and 2 as indicated in table I. These oils contain 20 per cent by weight of rosin in comparison with pure rosin for the same length of time. We are not able to account for this condition or phenomenon.

Although the iodine numbers of oils are important, the foundryman should not lose sight of the importance of saponification number, specific gravity, color, acid number, etc. Every item should be carefully checked.

Book Review

Proceedings of the American Society for Testing Materials, Vol. 29, 1929 in two parts, 1937 pages, 6 x 9 inches, paper, cloth or half leather, published by the American Society for Testing Materials, Philadelphia, and supplied by THE FOUNDRY, Cleveland, for $12.15 in paper; $13.15 in cloth, and $16.15 in half leather or in London by the Penton Publishing Co. Ltd., 413-17 Caxton House, Westminster, for £2 9s 3d in paper; £2 13s 5d in cloth, and £3 5s 9d in half leather, postage extra.

The first section of *Proceedings*, containing 921 pages is devoted to committee reports and tentative standards and includes the reports of such committees as A-3 on cast iron; A-5 on corrosion of iron and steel; A-10 on iron-chromium, iron-chromium-nickel and related alloys; B-2 on nonferrous metals and alloys; B-3 on corrosion of nonferrous metals and alloys; B-5 on copper and copper alloys, cast and wrought, and B-7 on light metals and alloys, cast and wrought. Submitted or revised tentative standards include those on chilled tread cast iron wheels and gray iron castings for valves, flanges and pipe fittings. Tentative revisions of A.S.T.M. standards include chilled cast iron wheels; chemical analysis of plain carbon steel; bronze bearing metal in ingot form, and chemical analysis of manganese bronze. In addition to the materials mentioned, changes in specifications for cement, lime, gypsum, concrete and clay products; preservative coatings; petroleum products and lubricants; road materials; coal; timber; waterproofing and roofing; insulating materials, etc. are given.

Part II of the *Proceedings* containing 1016 pages presents the papers and discussions which were presented at the 1929 meeting of the society held at Atlantic City, N. J. The volume contains 56 papers of which 11 relate to a symposium on the physical properties of cast iron; 18 to other metals than cast iron; 7 to cement, concrete, and brick; 12 to a symposium on mineral aggregates, and 8 to miscellaneous materials. The symposium on cast iron covered such subjects as static strength, elastic properties, fatigue testing, impact testing, wear testing, etc. The section devoted to metals includes data on steel forgings, reinforcement bars, corrosion of ferrous and nonferrous materials, fatigue testing, etc. Rate of hydration of cement clinker; compression test for portland cement; tests of powdered admixtures in concrete, water absorption and pentratability of brick, etc. are described in the section devoted to cement and concrete, and brick. The symposium on mineral aggregates includes papers on methods of inspection of mineral aggregates; fine aggregates in concrete, mortar and plaster, and bituminous mixtures; needed research on mineral aggregates, etc. Miscellaneous materials section contains papers on slate and related materials; white pigments; turpentine; oil; asphalt; a new test for measuring the fire resistance of wood, etc.

Table II

Oil Specifications

Specific gravity @ 60° F.—0.9360 maximum
Flash point (Cleveland open cup)—165-200 degrees. Fahr.
Fire point (Cleveland open cup)—190-225 degrees Fahr.
Iodine No. (Wijs, 15 min.)—155 minimum
Iodine No. (Wijs, one (1) hour)—160 minimum
Saponification number—148 minimum
Acid number—30-37
Color—Light clear amber through ½-inch section
Fish oil—Negative (Griffins test)
Ash content—0.20 per cent maximum
Gallonage—U. S. liquid gallon @ 60 degrees Fahr.

The purchaser reserves the right to subject each shipment, when received, to the above inspection and tests. Failure to pass any of them may be cause for the return of the shipment for full credit plus carrying charges both ways.

Offers Doctor's Degree in Metallurgy

Carnegie Institute of Technology, Pittsburgh, next fall will offer graduate courses leading to a doctor's degree in metallurgy. Previously the master's degree was the highest given in metallurgy at that institution. The courses will be offered by the department of mining and metallurgy of which Prof. James Aston is head, assisted by the bureau of metallurgical research directed by Dr. Francis M. Walters, Jr. The course of study has been outlined by Dr. V. N. Krivobok and includes courses in advanced metallurgy of iron and steel, corrosion of metals, advanced X-ray analysis, advanced electrochemistry and electrometallurgy, economic metallurgy, plant problems, refractories, physical chemistry of iron and steel making, metallurgical design and advanced testing of materials.

Celebrates Anniversary

W. A. Jones Foundry & Machine Co., Chicago, manufacturers of gears, gear drives, herringbone speed reducers, flexible couplings, pulleys, etc., is celebrating its fortieth anniversary this year. The executives of the company are: W. G. Jones, president; J. A. Sizer, secretary; G. W. Page, vice president in charge of purchasing; W. F. Coleman, vice president in charge of manufacturing and F. H. Hoge, vice president in charge of engineering. The board of directors includes the previously mentioned executives and William A. Jones and G. V. Jones.

Night School Opens

Cleveland college, the night school of Western Reserve university with affiliations with Case School of Applied Science, Cleveland, will open the second term of the school year Feb. 3. The college offers many courses that are of interest. These include business administration, engineering, languages and science. Courses are offered in both ferrous and nonferrous metallurgy and metallography.

Bill Discusses the Number of Foremen Required

By Pat Dwyer

HAVE you ever noticed," Bill inquired the other night, "that the clever comeback, the snappy retort, never flashes into your mind until it is too late to be of any use. You have to take the slings and arrows of fortune lying down and you have to cower in humiliation, or slink away in a corner with your tail figuratively between your legs, while—to follow the same simile—the other fellow struts around flapping his wings and crowing like a perishin' rainbow striped pride of the barnyard. These birds give me a pain. Up to the present I have resisted the temptation manfully, but some day I am going to twist a few of their silly necks."

"Whose necks?" I inquired. "In the present deplorable state of our language the term *bird* is applied to almost every object, animate and inanimate. It is used indiscriminately as a noun or an adjective. Even the golfers have included it in their peculiar jargon, where—probably to offset some of their more vitriolitic terms—they have toned it down to the diminutive and caressing *birdie*.

"Are you by any chance referring to the human beings who at one time or another practically wiped you off the slate, or, are you referring to those noble specimens of male barnyard pulchritude who greet the coming dawn with ringing paens of joy? They strut around the yard with their hands, figuratively, in their pockets and are galvanized into vigorous action only when the word is passed around that another egg has been added to the world's total. Without the slightest hesitation, without questioning the accuracy of the statement, they suck in an extra deep breath, stretch their necks to the elastic limit, brace their feet and announce in clarion tones that the world once more has been saved. Properly primed and in good trim on an occasion of this kind, one of these birds can make more noise than the whistle on the Lightning Mail running wild on a down grade with a sharp curve and a bridge at the bottom. Just one long screech after another and then over she goes, plop!" "What's the big idea of dragging in the wreck of the *Old* 97?" Bill inquired, coldly. "If you feel a burning desire to recite the remainder of that old mess of tripe, count me out. 'He tu'nd then to his black face fiahman. Just shovel in a little moah co-al'—Bah! As if any driver worthy of the name could indulge in such drivel, with the glass half full, with the steam going down and with half an hour to make up in a 20-mile run.

"What he probably said was: 'Hump yourself and keep humpin' you goggle eyed parallelogram! Jam 'er to the crown sheet! Keep 'er poppin'! or by the everlastin' Rock of Cashel I'll split you with a shovel from your black ivory knob to the patch on the back of your pants. Jump!'

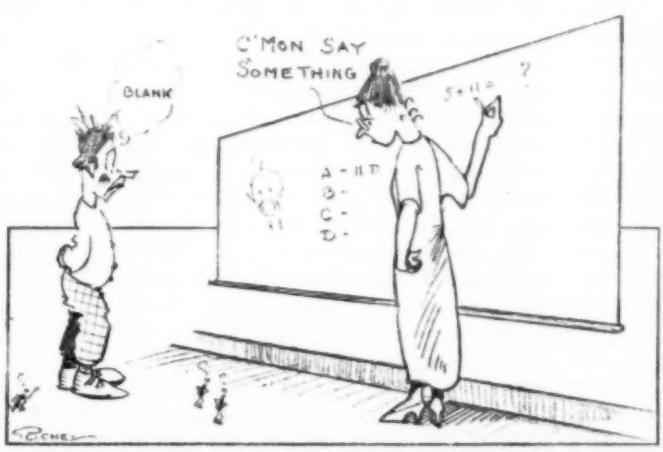
"These song writing birds—"

"Dear old pal," I interrupted hastily, "You are doing me a grave injustice. I had not the slightest intention of inflicting the wreck of the *Old* 97 on you. However, I am glad you brought the subject up. I always have felt there was something lacking in the reported remarks of the engineer. They were too casual, too easy going. They seemed to lack the sincerity, the depth of feeling one naturally associates with the state of mind of a man keyed to the highest pitch, desperately striving to overcome an apparently insurmountable handicap. Your clear and scholarly translation has cleared up that point in a perfectly satisfactory manner. Henceforth the driver on *Old* 97 will occupy the proper niche in my estimation, a credit to the profession."

"Sure he was," Bill said. "They all are. I've known dozens of these birds and every one of 'em—"

"Lay off that bird stuff," I said, "and let's get back to the beginning. What I was going to ask you when you dragged in all this rigmarole about the *Old* 97 was, what species of bird had you in mind when you expressed the earnest desire to twist their necks? Were you referring to the human beings who had put the bird on you, or, were you thinking of a real bona fide b-i-r-d, bird, with tail feathers, a yellow bill and a pair of claws?"

"Both of 'em," Bill replied shortly, "Both of 'em me boy. They all make too much noise and essentially I am a man of peace. I hate to get involved in an argument, partly because, as I say, I am an ardent disciple of, and believer in peace, and partly because as I said some time back, I can't think fast enough. The clever come back, the spear point for piercing the enemy's armor does not come to hand until after the opportunity for using it has passed. 'Tis sure a tough racket. The old army game first was worked on me in school when I was young and defenceless, at the mercy of a succession



REMEMBER WHEN YOU STOOD AND LOOKED LIKE THAT?

of teachers who knew everything while I knew nothing. At least I was consistent. I did not envy them their knowledge and had no desire to take any of it away from them. Unfortunately they did not show the same fairness or breadth of view. They tried by fair means and foul to corkscrew some of it into me. I resisted manfully to the best of my ability, but it was a losing fight from the beginning.

"I gradually acquired a more or less rudimentary knowledge of several subjects but the mysteries of arithmetic remained mysteries for many years. I bungled through them in a kind of a dumb way, but I never got what you might call a grip on them until I took up a night course of instruction several years after I had left school. My pet aversion—Oh! boy, didn't I hate it—was the problem of *A*, *B*, *C* and *D*. These birds were everlastingly engaged in digging a trench, or excavating a cellar or bailing water out of a tank. *A* could do the job alone in 11 days. *B* could do it in 9 days. *C* apparently was a bit of a soldier and required 13 days while *D* was a hustler and could do it in 7 days. The problem was to find out how long the entire gang would take if they were started off together on the job some fine morning.

"According to the teacher's method the thing was reduced to fractions with a common denominator. You multiplied them or divided them—I forget which—and there was the answer.

"The answer was right according to the figures, but as dumb as I was I felt there was something wrong about it. In later years I discovered the fallacy, but as I said some time back, the discovery came too late for me to rise up and denounce it. Two, three or four men working together never work as efficiently as an equal number of men working independently. The slow man is in every person's way and slows down the entire performance. Two men of equal ability doubled up on a job, will not do as much work in one day, as one of them can do in two days. Every foundry foreman is familiar with the fact that two men working with two patterns can put up a greater day's work, than two men working with one pattern and one set of flasks.

"Then there is the other old moss eaten tradition that two persons can live as cheaply as one. Ask any married man about that and have your ears blistered. 'Yes,' he will admit sourly, 'two can live as cheaply as one, if you amend it to one dozen.'

"Have you ever seen two men trying to make up their minds on a certain point? Where one man can arrive at a decision in an hour, two men will wrangle over the job for a week."

"Why don't you write to the papers about it?" I suggested. "It appears to me, it is about time for some gallant champion to lay a spear in rest and puncture some of these old fallacies."

"Well," said Bill, "I'll tell you, that kind of stuff has been going on for such a long time, that any protest of mine would amount to no more than the plaintive peep of a lonely pelican in the wilderness. However, a friend of mine in the East sent me a little pamphlet the other day which I think requires some comment. I shall outline the facts briefly and perhaps some day when you have time, we can get together on the composition of a ringing rejoinder. It will be a step in the right direction.

THE BOSS EXHORTETH THE PLUGS TO GREATER DILIGENCE

"The author of the pamphlet traces the development of the round projectile and claims that it began with Johnny Clawface the son of one of our prehistoric ancestors. Johnny found that he could manipulate a round pebble with greater force and skill than he could handle the jagged hunks of rock employed up to that time in war and in the chase.

"A touch of levity in one of the opening paragraphs leads me to doubt the accuracy of the entire thesis. Shortly after Johnny's birth, a few neighboring women dropped into the cave to give the new arrival the once over. Commenting on it later one said, 'He does not resemble his father.' A second gossip remarked that the child did not resemble the mother. The third member of the investigating committee was doubtful. 'The young imp,' she remarked kindly, 'looks to me more like a baboon.'

"The entire paper, in my opinion is grossly inaccurate and misleading in that it does not give any credit to the race that has done more than any other to popularize the art of stone throwing. The author has developed an ingenious theory, but in the interests of truth and justice—the everlasting rock on which all true science is based—I want to point out respectfully that the brochure is a compound of apple sauce and baloney.

"Not a word is said about the Irish, although—as every person knows—for centuries this race has enjoyed an enviable reputation for its individual and collective ability and readiness to throw missiles of any shape and size including the well known bull, with or without provocation. I have taken some pains to investigate this subject and present the following points for your consideration. You will recognize the authorities I quote as men of unquestioned standing in their respective fields of history, archeology and pure science. How's that for a start?

"Development and ability to throw missiles or projectiles of any kind with great force and accuracy, is a distinctly Irish accomplishment. The art has been known and practiced in the little green isle since the earliest times of which we have record.

"Shamus McGurk in *Ireland for the Irish*, claims that Brian Boru rolled an avalanche of round boulders down the slopes of Tara's hill and drove the Danes into the sea. St. Patrick gained the love and esteen of the pagans by showing them how to manipulate a slingshot and thus cripple the unbelievers at a safe distance.

"The round towers of Ireland, from the tops of which the defenders showered down cobble stones, indicate that the early inhabitants fully appreciated the strategic advantage of spherical construction for purpose of offense and defence.

"In *Erin-Go-Bragh*, vol. 11, page 576, we read: "The Feneecians, blacke and hairy sea dogges from foreign parts didde fall upon ye coaste of this lande and didde ravish itt cruelly, being aided therein bye their abilitie to sling girt round pebbles with greate force against ye scantilie

clad and tender inhabitants thereof."

"Apparently the Irish were adepts in picking up the new technique. From that day to this they have had no occasion to adopt immigration restriction laws against the Phoenicians!

"The Phoenicians learned the art of stone slinging from the Egyptians and the Egyptians in turn had stolen it with everything else portable, from the Israelites while these unfortunate people were laboring in the brickyards and eating the straw which should have been incorporated in the bricks.

"In this connection it is interesting to note that the term *straw boss* which originated at this period, has come down to us practically unchanged in meaning and application, a man whose officious zeal and energy usually are in inverse ratio to his importance. Duty of the Egyptian straw boss included the distribution of straw to the workers. The appropriation for the straw was voted, but in the usual process of filtration through many hands, the amount actually available and that actually spent for the straw, would go in the eye of a camel—or is it a needle? Some kind of an eye. Well anyway, all the straw boss got was the last straw and that, you might say, was just too bad!

HIGH LIGHTS OF HISTORY. DAVID IS MADE KING

"The Israelites were the first to discover the superiority of the spherical projectile over those previously in use. They also discovered many other interesting things, including the process of making money by the simple expedient of charging interest on their loans. However, that has no bearing on the present discussion. I merely mention it by way of giving credit where credit is due. They are great believers in credit—when secured by proper and ample collateral.

"King David was the first man to really popularize the use of the round pebble. His famous biography *Slinging for Pleasure and Profit* was an inspiration for thousands of young men. Dave knew what he was talking about. Ability to wield a wicked slingshot kept him in ease and comfort as the leader of a band of young marauders for many years in the hilly fastnesses of Judea. As the leading slinger of his day he was the logical successor to the throne when old King Saul finally kicked off. Other candidates just naturally oozed out of the running when brave Davy, with his trusty sling in his hands and a bag of shrewdly selected pebbles slung over one shoulder, appeared on the scene and calmly announced that he wanted the job. The other candidates craved a stone to mark their last resting place, but they did not hanker to have it planted prematurely in the middle of the forehead.

"Some day," Bill concluded, "I am going to write some of this stuff down and send it to the lad who sent me the pamphlet. I guess it will hold him for a while, and incidentally I will have the satisfaction of getting it off my mind. In the meantime, the reference to the straw bosses reminds me of an inquiry I had the other day from a foundryman who wanted to know if there is any recognized proportion between the number of foremen and the number of molders in a foundry. Specifically, does a foundry employing 30 molders need a superintendent and a number of assistants, or, is it customary just to employ a number of foremen. In the larger foundries employing 100 or more molders, are the executives proportioned according to the character of the work or to the amount of supervision required for efficient operation.

"The answer to the first question is *no* and the answer to the other two questions in a general way is *yes* to the first part of each. However, the scope of the questions is too wide to be dismissed with just a yes and no answer. Local conditions determine the amount of supervision required in any foundry with 30 or more molders. For example, in a jobbing shop where heavy castings predominate, one foreman and one assistant will supervise the activities of from 30 to 100 molders provided the molders are skilled workmen. An additional foreman will be required in the coreroom and another in the cleaning room. These two men take an active part in the work and are paid a slightly higher hourly rate than the other workmen. In some shops of this kind where the character of the work permits of subdivision, castings within definite weight or size limits are made in definite sections of the shop and a foreman attends to each division. In these cases the general foreman usually has other duties in addition to supervising the activities of the workmen. Usually he is classified as superintendent and deals directly with customers in soliciting work. He is the buffer between the management and the outside world.

"Where the work is of a routine character and the men are accustomed to it, one man can supervise the molding detail of a greater number of men than in a place where the work is of a miscellaneous character and where unskilled labor constantly has to be broken in. In stove foundries and other foundries of the same general character where the castings are fitted, finished and assembled into a salable product, a general superintendent has charge of the plant and a foreman looks after each division. The amount of supervision cannot be reckoned from the tonnage produced. One foreman will serve in an ingot mold foundry producing several hundred tons of castings per day, while a second man will be kept quite busy in another shop where the output of light castings may not exceed 5 tons. In fact in many instances the mass in the second shop will be the busier of the two.

"Personal characteristics of the foreman himself constitute an important factor. A mature, experienced foundryman accustomed to operating a foundry and familiar with every detail can supervise a far greater number of men, than a man who either through youth or inexperience has not the same background of knowledge."

Worthington Machinery Corp. of California, with headquarters in Los Angeles and San Francisco, has been incorporated to take over the sales and engineering staffs and the warehouse facilities of the Worthington Co., incorporated in California. Officers of the new company include H. D. Cornell, formerly president of the Worthington Co. of Oklahoma, as president and George W. Hawkins, formerly director of sales, the Worthington-California company, as vice president.

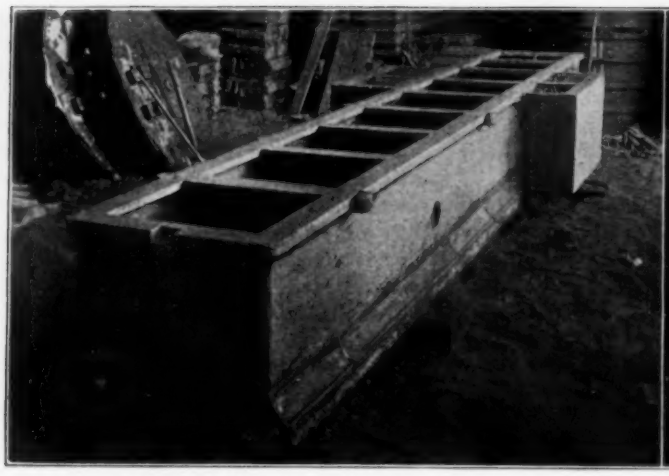


Fig. 1—Casting for a planer bed. Fig. 2—Mold partly rammed showing runner sticks and supports for the cope

Long Beds Warp in the Mold

By R. H. PALMER

THE size and other general features of a planer bed usually determine the style of pattern adopted and the method employed in making the mold. The smaller sizes are molded from a whole pattern with the necessary loose pieces and coreboxes. Unequal contraction strains and consequent distortion of the casting must be anticipated in making the mold for a long bed and suitable precautions must be adopted to insure a true, straight casting.

FIG. 3—MOLD WITH COPE REMOVED

The ends on a short bed usually will spring up where the pattern and mold have been perfectly straight. They will droop in the opposite direction on a long bed. The weight and length of the casting offset the contraction pull and the result is a casting humped up in the center. In practice the bed pattern is cambered to a predetermined degree to compensate for the anticipated warping of the casting. Thus in a short pattern the ends are lower than the center, while in a long pattern the ends are higher than the center. The terms lower and higher apply to the pattern in the position in which it is molded, that is with the ways down, or in the opposite position to that which they assume in service. No positive rule can be laid down to guide a beginner in the amount of camber to allow. A man of experience can approximate the amount closely and make minor adjustments on succeeding castings. Analysis of the iron, pouring temperature and condition of the mold are important factors which must be taken into con-

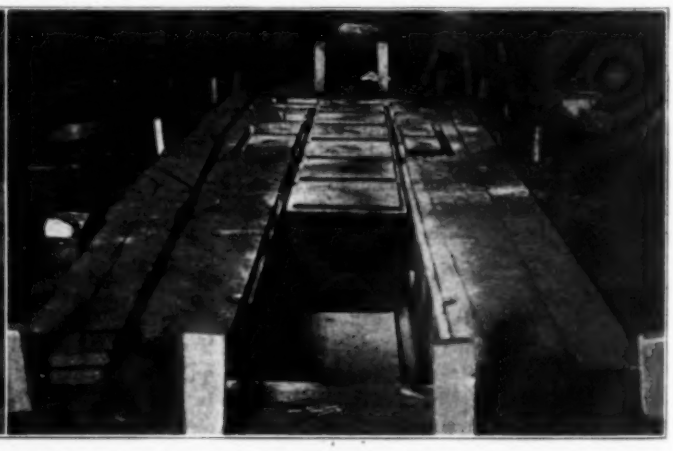


FIG. 4—MOLD WITH PATTERN REMOVED. FIG. 5—MOLD WITH SEVERAL OF THE CORES FOR FORMING THE INSIDE SET IN THE PROPER POSITION

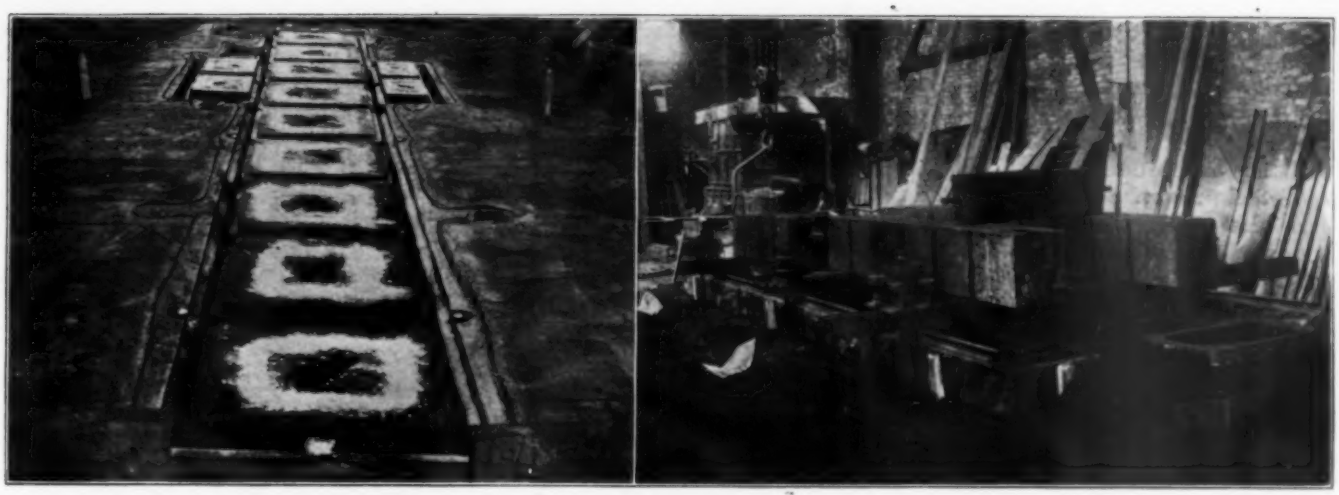


FIG. 6—THE MOLD IS SHOWN HERE WITH EVERYTHING IN READINESS TO RECEIVE THE COPE. FIG. 7—THE MOLD WAS POURED FROM BOTH ENDS. THE LADLE AT THE FAR END WAS SUPPORTED ON TEMPORARY PIERS MADE UP OF STOUT TIMBERS

sideration. The number of variables is so great that even in the best regulated foundry, a casting slightly bowed, occasionally comes out of the sand.

The accompanying illustrations show two methods for molding these castings. The more popular of the two and the one usually followed is shown in the series of illustrations numbered from 1 to 7. The pattern is molded in a pit dug in the floor. The outside of the mold is formed in green sand. In some instances the outer face is skin dried. The interior of the casting is formed with a number of dry sand cores. At one time and in some foundries the pattern left its own cores which were lifted on plates equipped with long staples. In some foundries the cores were made in coreboxes, but they were made from molding sand and were only skin dried.

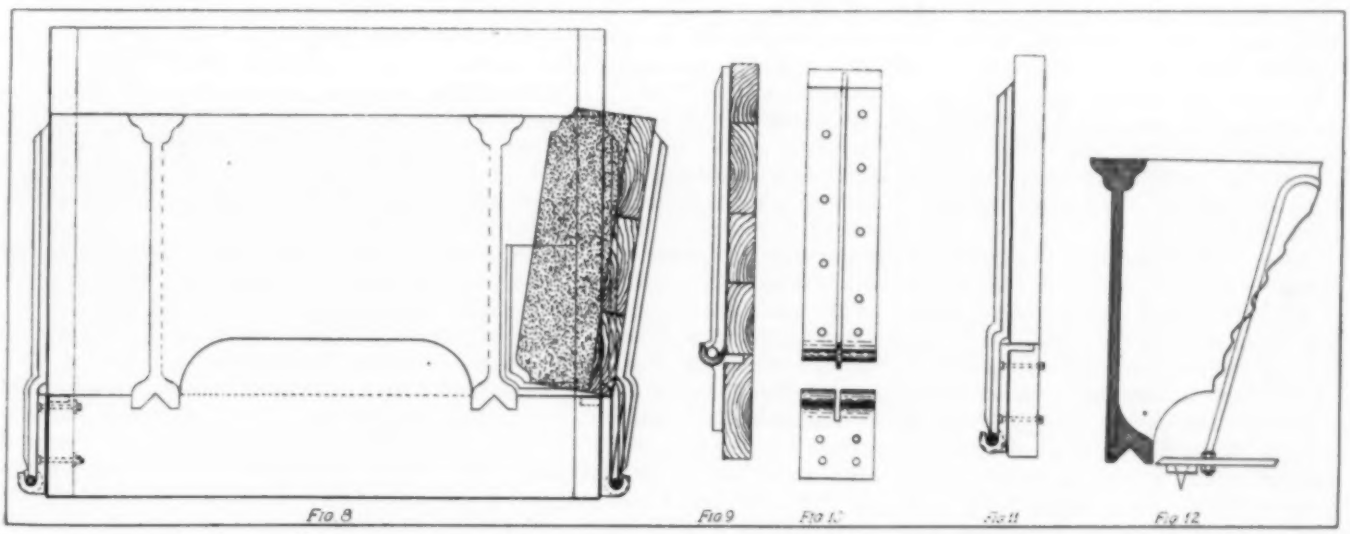
In the second method illustrated in Fig. 8 the mold is made in a three-part flask, made up of a drag, cheek and cope. The cope and drag are normal, but the cheek is hinged at the bottom joint and is rolled back instead of lifted, to permit removal of the pattern and subsequent finishing and blacking of the vertical faces of the mold.

Use Solid Pattern

A typical casting partly cleaned is shown in Fig. 1. One flat bottom runner has been broken off, but the other still is attached to the lower, right corner of the casting. In some instances a gate of this kind is formed in a dry sand core which is rammed in place in the general process of ramming sand around the pattern. Under other conditions a tapered gate stick is rammed in place and is drawn into the mold cavity after the main pattern has been removed. This gate may be placed flat as shown in Fig. 1 or, on edge as shown in the far end of the open mold, Fig. 4.

The pattern is a plain box with loose pieces on the lower outside edge to form that part of the sliding way in which the carriage moves when the planer is in operation. On some patterns these loose pieces are designed to draw in after the main pattern has been lifted out of the mold. They may be covered with green sand reinforced with a row of rods. Usually they are covered with a series of dry sand cores. In some instances the loose pattern strip is dispensed with entirely. A strip of sand is finished to the proper contour along the bottom edge of the pattern. The cores then are placed on this strip, with the upper edge butting against the vertical side of the pattern. In this manner the cores are employed as they are, for example, in forming the lower flange on a flask mold.

In the mold shown in various stages of progress in the accompanying illustrations, the pattern was bedded in a pit in the floor and sand was rammed on the outside up to a point



FIGS. 8, 9, 10, 11 AND 12—VARIOUS DETAILS IN THE CONSTRUCTION OF A CHEEK FOR A FLASK IN WHICH THE SIDE OF THE MOLD IS ROLLED BACK FROM THE PATTERN ON HINGES

where the surface of the loose piece begins to slant in and up toward the side of the pattern. The covering cores were rubbed to a bearing on the sand and on the loose piece and then marked or numbered to assure their return to the same place. The loose piece of the pattern was removed, the cores were replaced and the remainder of the pit was rammed full of sand in the usual manner. Courses of rods were laid at each ramming to reinforce the wall of sand.

Upright posts to form a bearing for the cope, also upright runner sticks at each end of the pattern are shown in Fig. 2. The pattern and gate sticks were faced with a mixture containing new and old sand in approximately equal parts and with one part coal dust to each 9 parts sand.

Vent the Mold

The cope was rammed in the usual manner and removed and then a long stout vent wire was employed to pierce a row of vent holes in the sand a few inches back from the vertical walls of the pattern all around. This feature may be noted quite distinctly in Fig. 6, also in the channels scatched in the sand for the escape of the gas from the vertical vent openings to the cope's outside edge.

The mold with the complete set of cores in place is shown in Fig. 6. The sand in front of the vent holes was ridged with the trowel to insure a close touch with the surface of the cope. A small amount of flour and parting sand was placed on the upper surface of the cores for the same purpose. The mold ready for the metal is shown in Fig. 7. In this particular instance only one crane was available and since the mold was designed to be poured from both ends, it became necessary to mount one large ladle on temporary piers at one end. Incidentally the same cope and floor space were employed in molding the table for this machine.

In a second foundry the same general procedure was followed with the exception that the loose strips were drawn in and the bottom *V* was formed with dry sand cores fastened down with spikes.

Many long beds are molded from a part pattern which is drawn along a level bed until the desired length has been attained. In still other instances patterns are made up in standard section lengths and two or more of these sections are assembled on a bed to form the desired length of casting. The center part of these various molds are formed with dry sand cores. In some foundries the ways are formed with chills instead of either green or dry sand.

In the past many planer and lathe beds were constructed with the ways joined and with the upper part of the pattern separate, but let into the lower. In molding these in a three-part flask the sides of the cheek were hinged at the joint of the cheek and drag as shown in Fig. 9. Others had the hinge placed lower as in Fig. 11. In Figs. 8 and 12 the side of the cheek is shown swung partly to one side. The ends were lifted on crabs or plates. Fig. 10 shows two parts of a hinge. The slot prevents the cheek from slipping to one side.

At one time, and I am afraid to some extent at present, patterns were and are made with little thought of the cost of making the mold. The aim is to make the pattern as cheaply

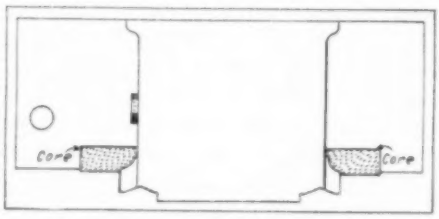


FIG. 13—DRY SAND CORES SUPPORT THE BODY OF SAND OVER THE CAVITY WHEN THE LOOSE PIECE OF THE PATTERN IS REMOVED

as possible and let the molder worry out a way of making the mold. Patternmakers often are instructed to construct a flimsy pattern because "Only one or two castings are required." Later, after the pattern has been used a great many times and comes in for a general repair the owner tells the patternmaker that he wishes he had made a substantial pattern at first. A cheap pattern keeps down the cost in the pattern department, but usually the foundry has to shoulder added cost in the production of the castings. If the pattern maker and foundry foreman consulted each other more freely, the ultimate cost of the castings in many instances would be reduced.

Removal of long castings from the sand is a question calling for experience and judgment. As long as heat remains, the casting has not contracted to its limit. I am reminded of a hurryup job where a long column was taken hot from the sand, cut to the specified length in a lathe and shipped. By the time it arrived at its destination it was cold—and too short. The hurryup foundryman had to supply a steel plate to bring the column to the right length.

To straighten a crooked bed casting the ends are placed on two supports and a fire is built under the center. A pedestal is erected under the center to receive and check the fall of the center beyond a predetermined point. This point is a little below a straight line. The casting will spring back more or less after the operation. The exact amount only can be learned through experience. Weights are placed on the center of the casting. They are allowed to remain until the casting has dropped to the pedestal and until after the fire has died down.

Large Aluminum Sphere Taxes Ingenuity

(*Concluded from Page* 104)

tion and the metal distributed to four preheated ladles.

The casting was poured from four gates spaced equally around the circumference. After pouring, the vertical plates rapidly were pulled from the cope so that the casting could contract normally. Forty minutes from the time pouring started, the cope was broken away and the casting pronounced successful. The second half of the sphere was made in a similar manner. Examination of the drag showed that it only needed a new coating and sweeping to allow its use for the second time. However, since the cope was destroyed by pulling the vertical plates, it had to be rebuilt. The entire job of making the two castings occupied four weeks time of one molder and two helpers.

When completed and decorated with a map of the world, the sphere or globe will be installed in the lobby of the *Daily News* building. It will be set in a 6-foot recess in the floor and mounted on a steel shaft placed at an angle of 23 degrees to represent the position of the earth revolving upon its axis. An inner driving shaft and worm gear will rotate the globe slowly.

Book Review

Thomas & Gilchrist, Bolckow & Vaughan, 1879-1929, 5 x 8 inches, 32 pages, issued by Bolckow Vaughan & Co. Ltd., Middlesbrough, England, as a souvenir of a revolutionary movement or achievement in the history of steel making.

This handsome little brochure printed on heavy stock with wide margins to the top and right of the deckle edge pages after the French fashion, and bound in mottled dark brown leather covers, marks the fiftieth anniversary of the successful completion of a long series of experiments by Sidney Gilchrist, Thomas and Percy Carlisle Gilchrist at the Cleveland steel works of Bolckow Vaughan & Co. Ltd. In addition to the reproductions of photographs of

Thomas and Gilchrist, the book also contains pictures of several other men, Sir Henry Bessemer, F. R. S., H. W. E. Bolckow, John Vaughan, E. Windsor Richards, Dr. J. E. Stead, F. R. S., who played a prominent part in the development and establishment of the basic bessemer process of making steel. In the light of recent development it is interesting to note that in the first practical demonstration of the process a 1½-ton converter was used. Circumstances and conditions leading up to the first experiments are set forth, also the reason that induced one of the men to *over* blow the charge, to reduce the phosphorus. A reproduction of an interesting table shows how the elimination of phosphorus proceeded during an early *blow*, May 3, 1879. Commencing with a phosphorus content of 1.52 per cent, the finished metal at the close of 21 minutes and 10 seconds, showed only 0.15 per cent phosphorus. Other tables show the gradual increase in production of steel in Great Britain and the continent of Europe between the years 1878 and 1900, both by the basic and other processes. The concluding chapter deals with several features of basic slag.

Will Foster Industrial Research

By H. W. Gillett

BATTELLE Memorial Institute is an endowed institution for scientific research in metallurgy, fuels and allied fields, established by the will of Gordon Battelle II, as a memorial to his father, Col. John Gordon Battelle, who died in 1919. In 1923 Gordon Battelle died suddenly from appendicitis, leaving no family. His mother died soon after, so this branch of the family is now extinct.

Realizing that this would be the case, he planned to perpetuate the family name in another way. The type of memorial he chose was that of an institute in which means were provided for the solution of industrial problems by the application of science. The legend over the door of the institute reads, "Original research is mankind's most powerful weapon in solving the problems of nature." The institute is a non-profit organization.

Institution Is Endowed

Endowment of the institute is sufficient so that it will provide for considerable research work on the institute's own funds. Even that would be but a drop in the bucket compared to the need of industry for research, so that the trustees, instead of planning for a definitely limited amount of service to the industries in the field of the institute's work, are providing a place and mechanism for industry to make this service as large as it pleases.

A magnificent laboratory has been built by the trustees across the street from the Ohio State university campus in Columbus, O. There is space sufficient to house many projects and workers. The four floors contain 57,000 square feet of floor space besides attic storage. The building also contains a small auditorium for scientific meetings, a large and beautiful library, a machine shop, carpenter shop, ample storeroom space, many well-arranged laboratories for research, and a huge industrial laboratory 30 x 130 x 36 feet high, served by a 5-ton crane, for semi-commercial work.

Not all of this space will be required for the work that can be done on the institute's own funds. The remainder is there for the use of industry. The bulk of the space will be equipped, ready for occupancy, and complete equipment for general use, such as for melting and casting any alloy, heat-treating, mechanical testing, metallography, chemical analyses, and physical measurements in general, will be supplied. This initial installation is being chosen for its general utility, so that only specialized equipment, applicable to a particular problem will need to be supplied.

Problems to be selected for attack by the institute's own staff will be those that are too general a nature, or not yet sufficiently pressing industrially to come into the category which industry will be likely to support on its own initiative. They will be of the type of the more general projects of public research institutions like the bureaus of mines and standards and the state universities, or of privately endowed institutions.

Research fellowships at Battelle will be something along the lines of those at Mellon institute or at the government laboratories. Information obtained through the efforts of the fellows will, however, not necessarily be public property, as is the case in the government laboratories, but can be safeguarded by patents or otherwise as the case may justify.

Describes Purpose

RECENT establishment of the Battelle Memorial institute, Columbus, O., will be of interest to many firms and individuals. This brief description of its aims and purposes is abstracted from an article that appeared in Mining and Metallurgy. The author is director of the Battelle Memorial institute.

Equipment Orders Gain

The index of gross orders for foundry equipment in December was 208.0 as compared with 128.6 in November, according to a recent report of the Foundry Equipment Manufacturers' association. The index of shipments in December was 201.9 compared with 152.2 in November. Unfilled orders in December was 473.2 against 445.4 in November. The base is the average monthly shipments for the years 1922-23-24. Comparison of monthly orders as presented by the association follow:

Month	1926	1927	1928	1929
Jan.	168.2	180.4	132.7	180.5
Feb.	154.9	198.0	123.6	197.0
March	157.3	131.1	138.6	209.4
April	113.2	130.0	107.7	172.6
May	128.5	134.8	335.6	177.7
June	133.5	138.4	149.1	177.3
July	127.3	89.9	94.8	219.3
Aug.	141.2	106.4	278.0	229.5
Sept.	114.0	80.4	170.0	216.3
Oct.	140.5	98.0	185.0	245.3
Nov.	133.4	95.8	197.8	178.6
Dec.	181.0	106.8	166.5	208.0

Castings Build Roads

Cast alloys steels will play an important part in the 1930 program of road building if the various types of road building machines exhibited at the road show held by the American Road Builders association in Atlantic City, N. J., in January are any criterion. Nearly all important machines shown contained some alloy steel castings. Due to the hard wear and severe service conditions these machines are subjected to, materials with the necessary physical properties are essential. In many places alloy steel castings have replaced parts which formerly were fabricated.

The Shakeout

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EDWIN BREMER, *Metallurgical Editor*
CHARLES VICKERS, *Nonferrous Editor*
NORMAN F. HINDLE, *Assistant Editor*

¶ Simplify Ingot Specifications

PRACTICALLY all nonferrous foundrymen and ingot producers will be interested in the efforts being made by the special committee of the American Society for Testing Materials on the promotion of general use of specifications for copper alloys in ingot form. According to a report submitted by G. H. Clamer, chairman, a total of 599 alloys are covered by specifications at the present time. Many of these give reasonable tolerances on the contained elements, but others are too close for practical use. To facilitate comparison of the alloys under specification, they were grouped according to composition and use. The composition classification contained 20 subdivisions and included copper-tin alloys arranged according to tin content; copper-tin-zinc alloys arranged in two groups; copper-lead-zinc alloys arranged in 13 groups; yellow brass containing aluminum; manganese bronze; aluminum bronze and nickel alloys. The tabulation on uses showed 302 different formulas for 81 uses. This is almost on the basis of four formulas for each use which indicates excellent possibilities of a simplification program. A little investigation may prove that one formula could cover many uses.

THAT there are excellent possibilities of reducing the existing specifications is shown in a statement by Mr. Clamer that some 40 different compositions existed which would be within the 85-5-5-5 composition. Extreme variations in that instance are: Copper, 83 to 86 per cent; lead, 4 to 6 per cent; tin, 4 to 6 per cent, and zinc, 4 to 6 per cent, and the following maximum limits, antimony, 0.25 per cent; iron, 0.35 per cent; nickel, 0.75 per cent; sulphur, 0.06 per cent; phosphorus, 0.06 per cent, and total impurities, 0.77 per cent. While this is only one example, undoubtedly many more will be found. However, much painstaking investigation will have to be made before practical maximum and minimum limits for any given composition can be established. Work of this nature will be of incalculable value as it undoubtedly will indicate the casting properties of the alloys as well as the physical properties.

THE special committee has recommended that the Nonferrous Metal institute sponsor an investigation of copper alloy ingot to supply data upon which to base further work of bringing about an agreement upon an optimum number of compositions and the development of equitable standards covering these compositions. Since these two points will benefit the producer of ingots as well as the consumer, it is hoped that those interested will put their shoulders to the wheel and put copper alloy ingot specifications on a firm basis.

¶ Who Holds The Sack?

WHILE the production of automobiles is increasing gradually, some business forecasters believe that the total output for 1930 will be considerably below that of 1929. The buying public does not seem as ready this year to trade in the old car and blossom out in a new, shiny model. In other words, the industry is meeting more sales resistance than was encountered a year ago.

SALES resistance often results in price cutting. Unless it is possible to cut production costs or buy raw or semifinished materials cheaper, profits of the car builder will be narrowed. This situation in the past has, in some instances, resulted in the vicious practice of trying to pass all the reductions on to the companies supplying the materials used in the construction of the automobile. Sometimes it has worked; at other times the seller of materials has refused to be forced into cutting prices.

THE same practice on the part of at least one automobile producer has been noted recently. This concern seeks to specify that in case of a reduction in the selling price of the automobile which it manufactures, the company supplying the raw materials must make a proportionate cut in the price of material furnished. In the case of foundrymen selling castings on a small margin of profit, such an agreement is out of the question, for obviously it is impossible for him to make such an agreement with his employes or those who supply his materials. Castings as well as other commodities, are sold today on the basis of cost plus a fair profit. The sales agreement, which the automobile manufacturer is trying to put into effect, might result in the wiping out of the profit and even in the sale of castings below the cost of production. Foundrymen are not ready to pull the chestnuts out of the fire for automobile manufacturers.

Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

THOMAS H. BEAULAC, formerly connected with the Worthington Pump & Machinery Corp., Harrison, N. J., has been placed in charge of the foundry of the Springer Lock Mfg. Co. Ltd., Belleville, Ont., Can. Prior to his association with the Worthington company he had charge of the foundry of the Franklin Foundry Co., Franklin, Pa.

George H. Chisholm, president, Atlas Steel Casting Co., Buffalo, has been elected a director of the Buffalo chamber of commerce.

Frank Curtis has been appointed assistant foreman of the pattern department, Verona, Pa., works, American Steel Foundries.

Walter Wood, president of R. D. Wood & Co., Philadelphia, returned to the United States, Jan. 17 after a brief visit in England.

Ralph R. Teetor, engineer, Perfect Circle Co., Hagerstown, Ind., has been elected a member of the council of the Society of Automotive Engineers. He will serve for 2 years.

H. H. Walkup, formerly foundry metallurgist, Westinghouse Air Brake Co., Wilmerding, Pa., has been appointed junior metallurgist at the bureau of standards, Washington.

G. R. Lyman has been appointed manager of sales of the manganese department, Pettibone Mulliken Co., Chicago. He formerly was general sales manager of the Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

E. T. Runge, cost consultant, National Founders association, Cleveland, addressed the monthly meeting of the Wisconsin Gray Iron Foundry group at a meeting held in the Hotel Schroeder, Milwaukee, Jan. 8, on the subject, "Practical Foundry Cost Problems."

Norman C. Naylor has been named vice president of the American Locomotive Co. and the Railway Steel-Spring Co., New York. J. D. Finn has been appointed secretary of the American Locomotive Co., succeeding W. S. Robertson, resigned.

John D. Capron, formerly research engineer, United States Cast Iron Pipe Co., Birmingham, Ala., has been elected president of the Glamorgan Pipe & Foundry Co., Lynchburg, Va. Prior to his appointment as research engineer with the United States Company, he was at the Chicago office of that company and later was publicity manager with headquarters at the main offices Burlington, N. J.

Charles E. Acker, assistant treasurer of the Baldwin Locomotive Works, Philadelphia, has been elected treasurer to succeed William De Kraft, who will become chairman of the finance committee of the United States Rubber Co. on Jan. 1.

W. P. Brown, formerly foundry superintendent Oklahoma Steel Casting Co., Tulsa Okla., recently was appointed steel foundry superintendent at the plant of the Stockham Pipe & Fittings Co., Birmingham, Ala.

Donald Campbell, Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., addressed the Society of Automotive Engineers at its annual meeting Jan. 20-24 at the Book-Cadillac hotel, Detroit, on the relation of foundry practice to engineering.

William F. Rasche, director of educational work at the Oakland-Pontiac division of General Motors, Pontiac, Mich., has been named principal and assistant director of the Milwaukee Vocational school, Milwaukee. He fills the vacancy caused by the death of William C. Sieker.

A. R. Sittig, formerly of the Chicago Heights plant of the American Manganese Steel Co., has been appointed to represent that company in the Cleveland district. Mr. Sittig's office will be at 1176 Union Trust building, Cleveland. He succeeds E. Francis.

A. F. Marwick, formerly general sales manager for the Pettibone-Mulliken Co., Chicago, has become affiliated with the Chicago district sales staff of the Taylor-Wharton Iron & Steel Co., High Bridge, N. J., and William Wharton Jr. & Co. Inc., Easton, Pa.

R. F. Harrington, metallurgist, Hunt-Spiller Mfg. Co., Boston, addressed the Hartford, Conn., chapter of the American Society for Steel Treating on Jan. 14. Mr. Harrington spoke on European foundry practice with special reference to control. He spoke of the stress European foundries were laying on scientific foundry practice and emphasized the fact that foundry operations were supervised by technically trained men, metallurgists and general engineers. Mr. Harrington is chairman of the American Foundrymen's association committee on conservation and reclamation of foundry sand.

John H. Watters, chairman of the board, National Radiator Corp., Johnstown, Pa., has been elected president of the company. He succeeds Grant Pierce, who has retired. Charles L. Crouse, vice president and general manager, and for many years assistant general sales manager, has been appointed general manager of sales.

A. H. Kramer, president, Advance Foundry Co., Dayton, O., was elected vice president of the Ohio Foundries association, Inc., at a meeting held at Columbus, O., Dec. 19. The election was held to fill the vacancy created by the resignation of George Alten, Alten's Foundry & Machine Works, Lancaster, O. Mr. Alten will remain on the board of directors of the association. Mr. Kramer has been a member of the board for several years.

J. R. Van Rensselaer, formerly sales representative for Taylor-Wharton Iron & Steel Co., High Bridge, N. J., at the office of the San Francisco distributor, now is located at the New York office of William Wharton Jr. & Co. Inc., Easton, Pa. G. V. Wood, formerly located at the High Bridge, N. J., plant of the Taylor-Wharton Iron & Steel Co., now is western sales manager for it and associated companies, with headquarters at San Francisco.

Re-Elects Officers

Stockholders of the Falcon Bronze Co., Youngstown, O., have re-elected the following officers: President and general manager, James L. Wick; vice president, Riddle H. Doeright; secretary John Noll and treasurer, E. E. Miller. These officers with C. H. Kennedy, who also was re-elected, constitute the board of directors. The stockholders agreed with the reports of the officers that the past year was a good one for the company.

Reliance Electric & Engineering Co., Cleveland, has moved its Pittsburgh office to new and enlarged quarters at 2300 Koppers building. B. J. Ballard continues as district sales manager and C. V. Gregory as assistant.

Obituary

John Murphy, for 30 years open-hearth superintendent, Scullin Steel Co., St. Louis, died Jan. 12. Mr. Murphy was born Feb. 14, 1869 at Harrisburg, Pa. He received his education in the public schools of that city and at the age of 16 went to work as door boy in the open-hearth department of the Pennsylvania Steel Co., Steelton, Pa., now a part of the Bethlehem Steel Co. Later he became associated with the Pottsville Iron & Steel Co., Pottsville, Pa. He resigned that position to become melter for the Wellman Iron & Steel Co., Thrulow, Pa. In 1897 he accepted a position as melter at the American Steel Foundries, Granite City, Ill. and in 1901 became associated with the Scullen Steel Co. as open-hearth superintendent. He occupied that position until his recent death.

George J. Long, director, United States Cast Iron Pipe Co., Burlington, N. J., died at his office in Louisville, Ky., Jan. 15. He was 77 years old.

Warren P. King, 64 years old, vice president of the Aluminum Co. of America, Pittsburgh, died of a heart attack at Sarasota, Fla., Jan. 15. Mr. King lived at Kirtland, O., for many years.

Make Plastic Cement

Botfield Refractories Co., Philadelphia has developed a new high temperature cement which will be sold under the trade name of adachrome plastic cement. The cement has a chromite base which is claimed to make it chemically inert, hard, dense, and highly refractory. It is said to be resistant to acid and basic slags, molten metal penetration, abrasion, erosion and chemical reaction in the burning of acid sludge. The cement is sold in a plastic form and may be used to lay up fireclay brick, silica brick, chrome brick, and high alumina brick. It also is adaptable for use as a surface coating material and as a binder in mixing patching materials for repairing refractory construction.

Publish Equipment Book

Titgen-Eastwood Co., Philadelphia, recently has issued a 78-page catalog of foundry equipment. The booklet is divided into seven sections dealing with cupolas and accessories, ladles and accessories, brass foundry equipment, core room equipment, sandblast machinery and dust arrestor equipment. The booklet is illustrated well with halftone reproductions of the various pieces of equipment. Each picture is accompanied with a description of the apparatus and the details of construction.

Steel Firms Consolidate

Kay Steel Wheel Co. and the Kay-Brunner Steel Casting Co., operating plants at Alhambra and Los Angeles, Calif., respectively, have consolidated to form the Kay-Brunner Steel Products Inc., with main offices at 2721 Elm street, Los Angeles. The plant at Alhambra will be devoted to the production of steel wheels and the one at Los Angeles to miscellaneous castings. Both plants manufacture electric furnace steel.

Foundry Association Directory

American Foundrymen's Association

President, FRED ERB, Erb-Joyce Foundry Co., General Motors building, Detroit; executive secretary treasurer, C. E. HOYT, 222 West Adams street, Chicago; technical secretary, R. E. KENNEDY, 222 West Adams street, Chicago.

Associated Brass Founders of New England

President, GEORGE W. THORNBURG, Crescent Park Brass Foundry, Watham, Mass.; secretary, R. B. BONNER, Somerville Machine & Foundry Co., 14 Kent street, Somerville, Mass. Meeting the fouth Wednesday of each month at the Engineers' club, Boston.

The Buffalo Foundrymen

President, J. MCARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 140 Chandler street. Meetings each month at club rooms, 140 Chandler street.

Central Illinois Foundrymen's Club

President, H. M. HIBE, Hire Foundry Co., Peoria, Ill.; secretary, FRANKLIN WHITEHEAD, The Meadows Mfg. Co., Bloomington, Ill.

Chicago Foundrymen's Club

President, H. P. EVANS, Pettibone-Mulliken Co.; secretary, ALBERT N. WALLIN, S. Obermayer Co., 2563 West Eighteenth street. Meetings first Thursday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, CARL S. NEUMANN, Union Mfg. Co., New Britain, Conn.; secretary, CHARLES S. PARKER, Charles Parker Co., Meriden, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association

President RUSSELL M. SCOTT, Packard Motor Car Co., Detroit; secretary, WILLIAM J. MUHLITNER, Great Lakes Foundry Sand Co., 2100 Penobscot building, Detroit. Meetings third Thursday in each month except December, June, July and August at Masonic temple.

East Bay Foundrymen's Association

Secretary O. R. MOLLER, Electric Steel Foundry Co. Inc., 1328 Second street, Berkeley, Calif.

Electric Steel Founders' Research Group

Director, R. A. BULL; Assistant Director, C. N. RING; Central Office, 541 Diversey Parkway, Chicago.

Gray Iron Institute

President, WALTER L. SEELBACH, Forest City-Walworth Run Foundries Co., Cleveland; secretary, ARTHUR J. TUSCANY, Terminal Tower building, Cleveland.

Malleable Iron Research Institute

President, R. R. FAUNTLEROY, Moline Malleable Iron Co., St. Charles, Ill.; secretary, ROBERT E. BELT, Union Trust building, Cleveland.

Metropolitan Brass Founders' Association

President WILLIAM EMBER, Jefferson Brass Foundry, 62 Delevan street, Brooklyn, N. Y.; secretary, WILLIAM E. PAULSON, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 2 Park avenue, New York.

Newark Foundrymen's Association

President, J. L. CARTER, Sachs-Barlow Foundries, Inc., Newark; secretary, W. H. MANTZ, Atlas Foundry Co., Irvington, N. J. Meeting called by president.

New England Foundrymen's Association

President, ERNEST F. STOCKWELL, Barbour-Stockwell Co., Cambridge, Mass.; secretary FRED F. STOCKWELL, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio Foundries Association Inc.

President, DON MCDANIEL, Hamilton Foundry & Machine Co., Hamilton, O.; secretary-manager, E. F. SCOTT, 418 Penton building, Cleveland.

Philadelphia Foundrymen's Association

President, C. F. HOPKINS, Ajax Metal Co., Philadelphia; secretary, EARL SPARKS, 1623 Sansom street, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Pittsburgh Foundrymen's Association

President, L. W. MESTA, Mesta Machine Co., Homestead, Pa.; secretary-treasurer, WILLIAM J. BRANT, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August at Fort Pitt hotel.

Quad-City Foundrymen's Association

President, F. W. KIRBY, John Deere Spreader Works, East Moline, Ill.; secretary-treasurer, J. P. BOADEN, Union Malleable Iron Co., East Moline, Ill. Meetings the third Monday of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

St. Louis District Foundrymen's Club

President, HORACE R. CULLING, Carondelet Foundry Co., St. Louis; secretary-treasurer, LEO J. FILSTEAD, John C. Kupferle Foundry Co., St. Louis.

Southern Metal Trades Association

President, JOHN S. SCHOFIELD, J. S. Schofield's Sons Co., Macon, Ga.; Secretary, W. E. DUNN JR., Flatiron building, Atlanta, Ga.

Steel Castings Development Bureau

Research Director, GEORGE BATTY, 500 Stock Exchange building, Philadelphia.

Steel Founders' Society of America

President, J. E. MCCAULEY, Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.; managing director, G. P. ROGERS, Graybar building, New York. Meetings: Cleveland, May 12-15, 1930.

Tri-City Technical Council

Chairman, C. F. SCHERER, Davenport Machine & Foundry Co., Davenport, Iowa; secretary, E. C. XANDER, assistant secretary, Tri-City Manufacturers association, Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association

President, WILLIAM HOPPENJANZ, The Star Foundry Co., 221 Main avenue, Covington, Ky.; secretary, GEORGE W. PIEHL, Wessling Bros. Foundry Co., 1607 McLean avenue, Cincinnati. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association

President, R. D. BONNEAU, Commutator Co., Minneapolis; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, south, Minneapolis. Meeting third Wednesday of each month at Athletic club.

Washington Foundrymen's Club

President, J. W. ORPHAN, Lake Union Foundry Co., 1703 Westlake avenue, Seattle; secretary, EDWARD C. GUSTIN, The Prescott Co., 1 West Lander street, Seattle. Meetings second and fourth Tuesdays of each month at the Elks Temple, Fourth avenue and Spring street.

Western Foundrymen's association

President, H. T. HORNSBY, Joplin, Mo.; secretary, E. L. GRAHAM, Acme Foundry & Machine Co., Coffeyville, Kans.

Wisconsin Gray Iron Foundry Group

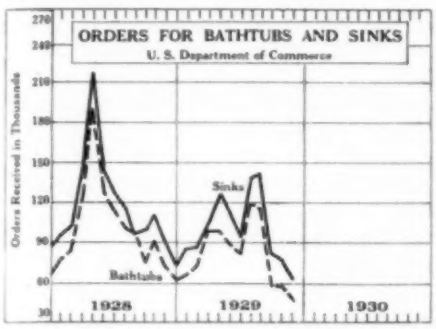
Secretary, W. F. BORNFLETH, Cutler-Hammer Inc., Foundry Division, Milwaukee. Meetings on first Wednesday of each month at Hotel Schroeder, Milwaukee.

Trade Trends in Tabloid

INQUIRIES for cast iron pipe through the east and in New England indicate that early portion of 1930 will be more active than the same period last year. Eastern pipe foundries are operating at about 60 per cent and southern works at 75 per cent of capacity.

—T-T—

Construction contracts in December amounted to more than three hundred sixteen million, according to a report of the F. W. Dodge Corp. This is 27 per cent below the total for December, 1928 and 19 per cent bellow November, 1929. A more encouraging situation is revealed in the record of contemplated projects in December, which amounted to eight hundred sixty-four million. This is a gain of 19 per cent over the amount reported in December, 1928.



—T-T—

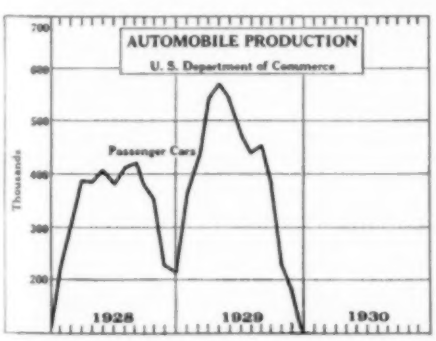
Resumption of activity is noted among foundries in the St. Louis district, notably in jobbing and stove casting lines. Substantial specifications for malleable castings for the automotive industry also are noted.

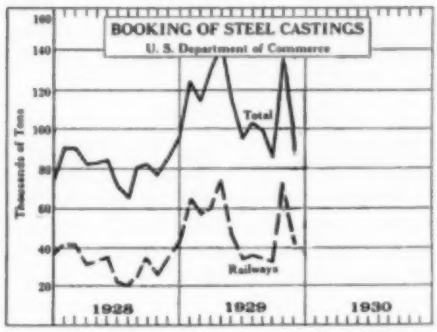
—T-T—

December automobile production was the lowest since the depression period of 1921 and 1922, with a total of 119,950 cars and trucks.

—T-T—

New freight car inquiry is light since the first of the year, but about 20,000 cars are actively pending from the closing weeks of 1929. Totals





for December of 9710 units brought the freight car orders for the past year to 106,105, more than the combined total for 1927 and 1928.

—T-T—

Demand for jobbing motor car castings is increasing in the Cleveland district.

—T-T—

Industrial and chemical works and railway supply inquiry for brass castings is bringing work to Chicago foundries.

—T-T—

General Motors foundries at Saginaw have increased production. On Jan. 14, the gray iron division was reported at 80 per cent of capacity.

—T-T—

General Steel Castings Co., Commonwealth division, Granite City, Ill., is employing about 3200, which is about 400 above normal. The American Car & Foundry Co. plant at that city with about 1600 employes is at a peak for the past five years.

—T-T—

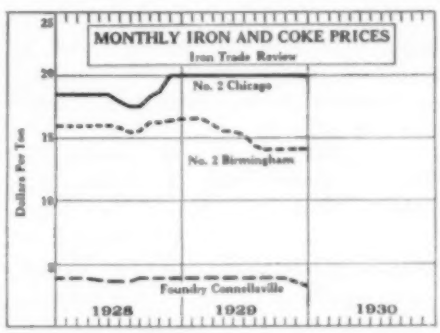
American Malleable Co., Owosso, Mich., has started the second of three furnaces after being idle for several weeks.

—T-T—

Production of 33 iron foundries in Philadelphia shows a slight decrease with the closing months of 1929.

—T-T—

Loadings of revenue freight in the first week of 1930 totaled 776,259 cars, an increase of 137,814 cars over the preceding week. Compared with the corresponding week in 1929, the total for the week represents a decline of 22,423 cars.



—T-T—

With pig iron showing a slightly easier trend, sales of iron increased gradually as the month of January progressed.

—T-T—

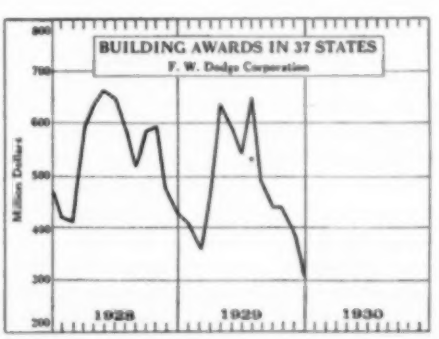
Reports indicate that sales prospects for machine tools in the western territory appear promising for 1930.

—T-T—

An increased attendance of the New York automobile show was taken as an indication of a greater demand than previously was anticipated. Several companies have increased production schedules recently including Chevrolet, Ford, Hudson-Essex, and others.

RAW MATERIAL PRICES
Jan. 22, 1930

Iron	
No. 2 foundry, Valley	$18.50
No. 2 Southern, Birmingham	15.00
No. 2 foundry, Chicago	20.00
No. 2 foundry, Philadelphia	20.76 to 21.26
No. 2 foundry, Buffalo	18.50
Basic, Valley	18.50
Basic, Buffalo	18.00
Malleable, Chicago	20.00
Malleable, Buffalo	19.00
Coke	
Connellsville beehive coke	$3.50 to 4.85
Wise county beehive coke	4.25 to 5.00
Detroit by-product coke	9.00
Scrap	
Heavy melting steel, Valley	$16.25 to 16.75
Heavy melting steel, Pitts.	16.50 to 17.00
Heavy melting steel, Chicago	12.75 to 13.25
Stove plate, Buffalo	12.50
Stove plate, Chicago	10.75 to 11.25
No. 1 cast, New York	9.75 to 10.50
No. 1 cast, Chicago	13.50 to 14.00
No. 1 cast, Philadelphia	15.50 to 16.00
No. 1 cast, Pittsburgh	15.00 to 15.50
No. 1 cast, Birmingham	12.00 to 13.00
Car wheels, iron, Pittsburgh	15.00 to 15.50
Car wheels, iron, Chicago	14.00 to 14.50
Railroad malleable, Chicago	16.50 to 17.00
Agricultural mal., Chicago	13.75 to 14.25
Malleable, Buffalo	17.00 to 17.50
Nonferrous Metals	**Cents per pound**
Casting, copper, refinery	17.00 to 17.12½
Electro, copper, producers	18.00
Straits, tin	38.12½ to 38.25
Lead, New York	6.25
Antimony, New York	8.75
Nickel, electro	35.00
Aluminum, No. 12, producers	23.00
Aluminum, No. 12, remelt	16.25 to 16.75
Zinc, East St. Louis, Ill.	5.25



University of Wisconsin Plans Conference

The fourth annual foundry conference of the department of mining and metallurgy, University of Wisconsin, will be held at Madison, Wis., Feb. 2 to 6. These conferences have been organized to permit foundrymen to pursue short courses of instruction covering fundamental principals and practices of the foundry industry. As has been the practice at other conferences, the round table method of presenting problems will be followed this year.

The conference program will open at 2 p.m. Tuesday, Feb. 4 with talks by C. R. Messinger, Chain Belt Co., Milwaukee, L. R. Clausen, J. I. Case Co., Racine, Wis., Francis B. Foley, Midvale Co., Philadelphia, and D. G. Anderson, Western Electric Co., Chicago. The following subjects will be discussed at the round table meetings on Wednesday and Thursday: Cupola practice by C. J. Scullin, Scullin Tucker Laboratories, St. Louis, and Thomas G. Stewart, J. I. Case Co., Racine, Wis.

Sand conditioning by Harry W. Dietert, U. S. Radiator Corp., Detroit.

Foundry practice by E. M. Handley, Chain Belt Co., Milwaukee, and Wm. P. Bradley, National Steel Foundries, Milwaukee.

Steel castings by B. Aamodt, Milwaukee Steel Foundry Co., Milwaukee and J. C. Schweitzer, Sivyer Steel Casting Co., Milwaukee.

Malleable iron by P. C. De Bruyne, Moline Malleable Iron Co., St. Charles, Ill., and Dr. Anson Hays, American Rolling Mill Co., Middletown, O.

High test iron by Dr. Fritz Meyer, National Radiator Co., Johnstown, Pa.

Heat treatment of steel by F. Kubosch, Thurner Heat Treating Co., Milwaukee and J. R. Houston, Harnischfeger Corp., Milwaukee.

Foundry management by H. B. Hanley, American Laundry Machinery Co., Rochester, N. Y.

Apprentice training by C. J. Freund, Falk Corp., Milwaukee.

The annual banquet will be held Tuesday evening.

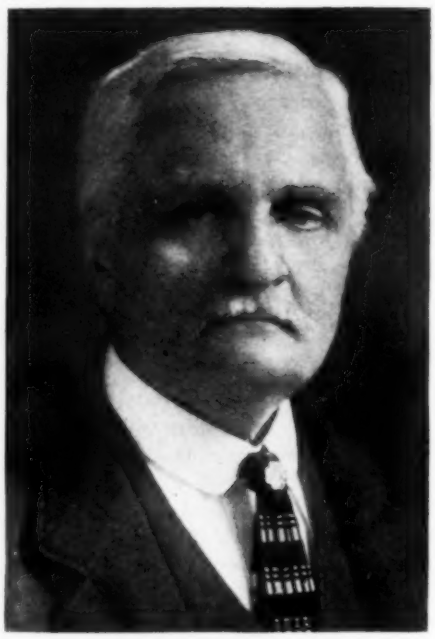
Add Staff Member

In connection with the general expansion program of the Austin Co., Cleveland, George A. Bryant Jr., executive vice president, has just announced appointment of Ralph Leavenworth as a member of the company's general sales department. Mr. Leavenworth, as an assistant to Mr. Bryant, will have contact with the sales activities of the headquarters office and the various branch offices throughout the country.

Prior to joining the Austin company staff, Mr. Leavenworth was secretary and account executive of Paul Teas Inc., advertising agency. He is vice president of the Cleveland Advertising club.

Wilfred Lewis Is Dead

Wilfred Lewis, former president, Tabor Mfg. Co., Philadelphia, and a noted engineer, died recently at sea off Egypt while on a world cruise. His death resulted from a stroke of apoplexy and he was buried at sea



WILFRED LEWIS

from the steamship PRESIDENT WILSON on which he and Mrs. Lewis left this country in September.

Mr. Lewis was born in Philadelphia on Oct. 16, 1854. He was graduated from Friends Central school, Philadelphia, in 1871 and received a B. S. degree in mechanical engineering from the Massachusetts Institute of Technology, Cambridge, Mass., in 1875. He then became connected with William Sellers & Co., Philadelphia, serving as a mechanic from 1875 to 1878, draftsman from 1878 to 1882, and designer, assistant engineer and director from 1883 to 1900. He then became president of the Tabor Mfg. Co., serving in that capacity until his retirement a year ago.

International recognition was accorded Mr. Lewis for his inventive ability and his work on the construction and design of gear teeth. Two years ago the American Society of Mechanical Engineers awarded him a gold medal for his accomplishments, especially his contributions to the design of gears. In 1902 the Franklin institute, Philadelphia, awarded the John Scott medal to Mr. Lewis and E. Mumford for their joint contribution to the design of molding machines. Two years later, the Longstreth medal, another award of the Franklin institute, was presented to Mr. Lewis.

He was a life member of the American Society of Mechanical Engineers and served as a vice president of that organization from 1901 to 1903. He was chairman of the science and arts committee of the Franklin institute, a member of the Engineers clubs of Philadelphia and New York.

Elected President

Carl E. Grunsky, San Francisco, past president, American Society of Civil Engineers, was elected president of the American Engineering council, 29 West Thirty-ninth street, New York, at the opening session of the annual meeting held at the Mayflower hotel, Washington, Jan. 10-11. Mr. Grunsky will serve during 1930 and 1931 and succeeds Arthur W. Berresford of New York, past president of the American Institute of Electrical Engineers.

The following vice presidents were chosen: L. B. Stillwell, New York, American Institute of Electrical Engineers; Major Gardner S. Williams, Ann Arbor, Mich., Detroit Engineering society; O. H. Koch, Dallas, Tex., Technical Club of Dallas; L. P. Alford, New York, American Society of Mechanical Engineers. Dr. Harrison E. Howe of Washington, representing the American Institute of Chemical Engineers, was re-elected treasurer. Lawrence W. Wallace, Washington, continues as executive secretary. He has held that post since the formation of the council as the public service body of the engineering profession in 1919. President Hoover was the first president of the society.

Chicago Club Will Meet

Two speakers will share the program of the February meeting of the Chicago Foundrymen's club, at the City club on Thursday evening, Feb. 6. V. A. Crosby, metallurgist, Studebaker Corp., South Bend, Ind., will speak on technical control and metallurgy in the foundry, and E. W. Page, Victor X-Ray Corp., Chicago, will present studies of the structure and casting technique of foundry products.

Gordon Thornton has been added to the personnel of the Cleveland office of the United States Electrical Tool Co., Cincinnati.

Compressor Is Equipped With Ball Bearings

Ingersoll-Rand Co., New York, has introduced a new line of air-cooled, two-stage air compressors in which the V-type belt drive is employed. Both motor and compressor are equipped with ball bearings.

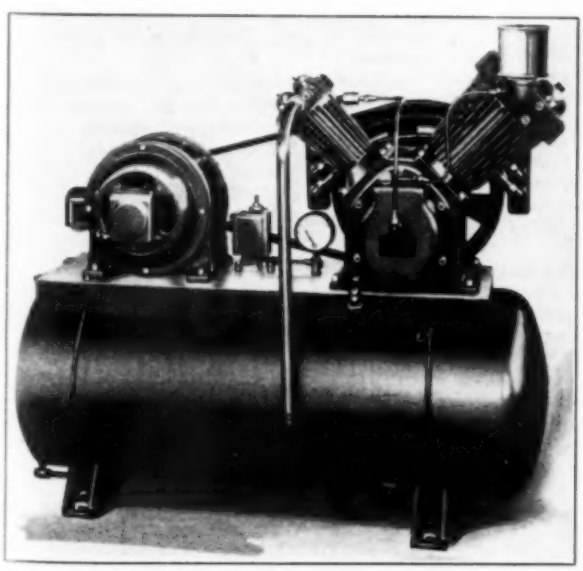
The units are self-contained. Motor and compressor are mounted on a steel base, which is attached to the top of the air receiver. The latter is made of heavy pressed steel and is built to withstand a working pressure of 200 pounds. No special foundation is required for correct alignment of the compressor and motor.

The intercooler is located behind the fan-type flywheel, and a constant current of circulating air is driven directly across the cooling coils. This reduces the temperature of the discharge air.

Automatic start and stop control, supplied as standard equipment, operates independently, but in conjunction with the unloader. When the pressure in the air receiver reaches a point at which the regulator is set to unload, the motor is shut off automatically. A centrifugal governor allows the air in the high-pressure cylinder and intercooler to exhaust through the crankcase. This prevents the compressor from starting against a load. Honed cylinders and two oil control rings reduce the oil in discharge air to a minimum.

The base of the compressor unit forms a reservoir for the lubricant. No oil pump is required. A bayonet gage gives positive indication of the amount of oil in the reservoir.

A cleaner keeps dirt from the compressor and requires no attention. The compressor is entirely enclosed. A balanced crankshaft, minimizes vibration. The machine is built in four sizes: ¾, 1½, 3, and 5 horsepower. All sizes are built for a working pressure up to 200 pounds continuous duty.



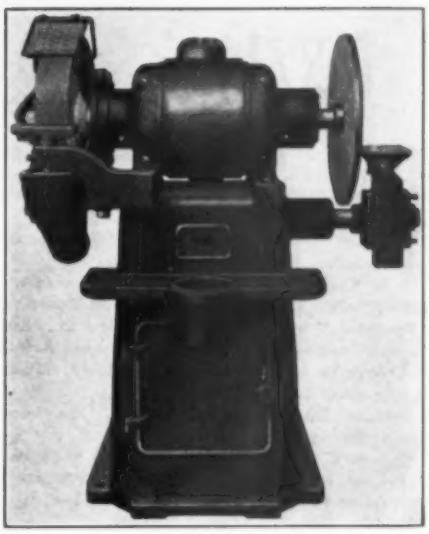
NO SPECIAL FOUNDATION IS REQUIRED FOR ALIGNMENT OF COMPRESSOR AND MOTOR

Increases Personnel

William C. Babbitt, for the past 10 years employed in the industrial management and trade association fields, has been added to the staff of the Industrial Truck association, 52 Vanderbilt avenue, New York, as field engineer. Mr. Babbitt will conduct a series of field surveys on the material handling methods in a variety of fields. Surveys are scheduled for the foundry, automobile, ceramic, iron and steel, metal working, pulp and paper, marine terminal, railroad terminal and warehouse industries.

Makes Combination Disk and Production Grinder

Hammond Machinery Builders Inc., Kalamazoo, Mich., recently has introduced a combination disk and production grinder, designed for installations where disk grinding operations are limited. The machine is made in four sizes having capacities of 2, 3, 5, and 7½ horsepower, for 220 and 440 volt, 25 to 60 cycles alternating current and 110 and 220 volt direct current. Standard equipment includes an adjustable steel wheel guard, steel disk, and plain table as shown in the accompanying illustration. The machine also is furnished with a universal lever feed table instead of the plain table if it is desired. The machines are constructed so that disks may be used on both ends if necessary. The grinder is equipped with a totally enclosed motor fitted with an air cleaner to supply ventilation to the motor windows. Each machine has push button control, automatic starters with thermal overload, low voltage and phase failure protection. The machine is equipped with ball bearings protected by double labyrinth seals. Bearings are designed and mounted to take both radial and lateral thrusts. The machine is supplied with oil reservoirs and cups, oil level gage and drain plug. Disks supplied with the machine are machined on both sides and may be reserved when they are worn. Wheel presses for mounting the disks on the machine are supplied when ordered by the customer.



THE GRINDER IS MADE IN FOUR SIZES

Book Review

Die Betriebspraxis der Eisen-, Stahl- und Metallgiesserei, Part VIII, Organisation und Selbstkostenberechnung in den Metallgiessereien, by E. Becker, paper or cloth, 96 pages, 6½ x 9¼ inches, published by Wilhelm Knapp, Halle (Saale), Germany, and supplied by THE FOUNDRY, Cleveland, for $2 in paper and $2.50 in cloth plus 15 cents postage, or in London by the Penton Publishing Co. Ltd., 416-17 Caxton House, Westminster, for 10s in paper and 12s 6d in cloth.

As its title indicates this volume deals with the organization and cost accounting in metal foundries, and is the eighth of a series of books dealing with management practice in iron, steel and metal foundries edited under the direction of Hubert Hermanns. This book is divided into four sections which deal with the various phases of cost accounting as applied to foundries. The first section discusses the arrangement of the costs and the component cost items, values of materials, wages, and overhead. The second section gives the general scheme of the accounting plan and then takes up the separate items such as value of materials account, overhead, product account, and the recapitulation account. The third section describes the rationalization of methods of ordering, wages paid, material departments, melting, molders, melting machines cleaning, and pattern handling. The fourth section deals with casting estimations, and covers such items as the foundation for estimating, compilation of estimation figures, production control and contract considerations.

What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Rockwood Stove Works, Rockwood, Tenn., plans a plant expansion.

J. S. Cushing Co., Norwood, Mass., is erecting an addition, 25 x 60 feet, to its foundry.

Sterling Foundry Co., Wellington, O., has resumed operations after a ten-day shut down.

A foundry will be opened at Amory, Miss., in the near future.

Bellaire Stove Co., Bellaire, O., has been closed for inventory and repairs.

Goliner Machine Co., Mineral Point, Wis., has completed the construction of a new foundry. Operations in the new building began Jan. 2.

Novelty Foundry, Peter Nielson, proprietor, has moved its foundry to a new location at 540 Kamani street, Honolulu, Hawaii.

Pacific Brass Foundry Co., Seattle, Wash., has been incorporated by John Carey, 5271 Forty-fifth street southwest, and associates.

Kilby Car & Foundry Co., 630 West Tenth street, Anniston, Ala., probably will add to production facilities in 1930.

Western Foundry Co., Kedzie avenue at Thirty-sixth street, Chicago, recently has completed a new addition to its plant.

Amarillo Foundry Co., Amarillo, Tex., has been incorporated with $25,000 capital by J. W. Sell to operate a gray iron foundry.

Western Iron Foundry, 514 University building, Denver, Colo., has been incorporated with $50,000 capital by J. E. Higson.

Anderson Stove Co., Anderson, Ind., has resumed operations after being shut down since Nov. 15.

Alloy Steel & Metals Co., 1862 East Fifty-fifth street, Los Angeles, has purchased new equipment to increase its capacity.

Podas Foundry Co., 6244 South Alameda street, Los Angeles, has purchased additional equipment for its cleaning department.

Lee Pattern & Mfg. Co., now is occupying its new plant at 754-756 East Florence avenue, Los Angeles.

Gaffers & Sattler, 4561 East Fiftieth street, Los Angeles, is building a 60 x 60 foot addition to its stove foundry.

The foundry of the Liberman & Gittlen Metal Co., Grand Rapids, Mich., was damaged by an explosion Dec. 24.

Doran Co., Seattle, has been incorporated by Earl D. Doran, 2303 South Thirty-third street, with $100,000 to operate a general foundry and machine shop.

Schaible Foundry & Brass Works, Dane and Knowlton streets, Cincinnati, is contemplating a plant addition. Cost probably will be about $25,000.

Sparta Foundry, Sparta, Mich., maker of piston rings, announces a plant addition. Production will be increased to 300,000 rings daily.

American Foundry Co., 906 Date street, Los Angeles, is completing a new office building, 26 x 26 feet and has installed some new equipment in the core room.

Eagle Foundry Co., Belleville, Ill., has begun to place a new plant in operation at East St. Louis, Ill., for the manufacture of stoves.

Municipal Foundries Inc., 652 Seventy-seventh street, West Allis, Wis., specialists in castings for municipal work,, will build a 50 x 50-foot shop addition.

Aylward Sons Co., 701 Main street, Neenah, Wis., will build a foundry addition in the spring although details are not yet available. William Aylward is secretary and manager.

Milwaukee Gray Iron Foundry Co., Thirty-ninth avenue and Mitchell street, Milwaukee, Wis., plans a core room addition, 35 x 135 feet, and a core oven building, 25 x 40 feet.

Mackintosh Hemphill Co., Twelfth & Etna streets, Pittsburgh, will improve its plant at Midland, O., in 1930 with an expenditure of approximately $90,000.

East Branch Foundry, East Branch, N. Y., owned by Walsh Bros., 215 Montague street, Brooklyn, N. Y., was damaged recently by fire.

The Huron Gray Iron Foundry Co., Ypsilanti, Mich., plans an additional building to house cleaning and sandblasting machinery to be moved from the main plant to facilitate expansion.

Wisconsin Grey Iron Foundry Co., Thirty-ninth avenue and Burnham street, Milwaukee, has let the general contract for a 2-story shop addition to Martin Jezo, 597 Fifty-first avenue. Cost will be about $25,000.

Tennessee Stove Works, East Fourteenth street, Chattanooga, Tenn., will erect an additional enameling plant and install an electric furnace, the entire project to cost approximately $200,000. Ben M. Rawlings, is president.

Edgely Brass Co., Edgely, Pa., has been incorporated with $50,000 to make castings, tools and fixtures and conduct a machine shop and foundry. Fred A. Barton, Mercerville, N. J., is treasurer.

K. & W. Casting & Sales Co., Salem, Mass., has been incorporated with $10,000 by S. Hadley Ware, 224 Lafayette street, president and treasurer, to operate a foundry and manufacture castings, machinery and tools.

Kinloch Brass Casting Co., St. Louis, is receiving new bids for a one and 2-story machine shop, 40 x 105 feet, at Twenty-second and Howard streets. Philip Coloninus, 2356 Palm street, takes bids.

Board of education, 500 Park avenue, New York, plans to construct a 7-story technical high school at DeKalb and Greene avenues, Brooklyn, N. Y., to cost about $6,000,000. School will include foundry.

Canadian Steel Foundries Ltd., 307 Craig street west, Montreal, Que., has awarded general contract to John McGregor Ltd., 1410 Stanley street, Montreal, for plant addition on Notre Dame street, Longue Pointe, Que.

Texas Electric Steel Castings, Houston, Tex., will build a 100 x 127 foot addition to its foundry and will erect a pattern storage, 35 x 65 feet. Molding machines will be installed in the new addition as soon as it is complete.

Standard Brake Shoe & Foundry Co., Pine Bluff, Ark., which has been operated as a corporation, hereafter will be operated as a co-partnership composed of F. L. Dilley and E. S. Dilley.

Completion of the new foundry building being erected by the Haynes Stellite Co., Kokomo, Ind., has been delayed. The new building will not be completed until February. (Noted Dec. 1.)

Star Brass Foundry recently purchased a tract of land at 1221 East Sixty-third street, Los Angeles and erected a foundry building. The company began business at the new location Dec. 1. Walter Lohwasser is proprietor.

United Casting Co., Wilson and Violet streets, Los Angeles, has been improving its foundry by relocating some equipment and replacing wooden beams in the structure with steel I-beams.

Lycoming Mfg. Co., Williamsport, Pa., manufacturer of engines, plans an expansion program costing approximately $1,500,000. Plant buildings, core room, additional machinery and equipment will be needed. W. H. Beal is vice-president.

Formation of Kay Brunner Steel Products Inc. has been effected to take over the assets of the Brunner Steel Casting Co. and the Kay Steel Wheel Co., both of Los Angeles. Company holdings include two large plants, one in Los Angeles and the other in Alhambra.

American Cast Iron Pipe Co., Birmingham, Ala., will erect a building at its monocast plant, Pearl and Tuscaloosa streets. Contract has been let to Southern Steel Works Co., contractors, 908 Lanier avenue. Cost will be approximately $15,000.

St. John Iron Works, Vulcan street, St. John, N. B., recently has completed the reconstruction of the Union Foundry & Machine Works, Ltd., which was purchased from the harbor authorities and moved from the western side of the harbor to a location on the property of the St. John Iron Works. (Noted Nov. 15.)

Durox Steel Casting Corp., 688 Rio street, Los Angeles, has been reorganized and the name has been changed to the Peerless Steel Foundry Co. V. T. Hohaus formerly connected with the Ohio Steel Foundry Co., Springfield, O., is president and general manager.

H. B. Sackett Screen & Schute Co., has acquired the plant of the W. A. Jones Foundry & Machine Co., located at Elston and Wabansia avenues, Chicago. The Sackett company has occupied the plant for a number of years. The Jones company will continue to operate its other plants.

New Trade Publications

ELECTRIC HEAT—General Electric Co., Schenectady, N. Y., describes the application of electric heat to the metal, ceramic, chemical, printing, food, and other industries in a recent folder. The bulletin is illustrated with reproductions from photographs of typical installations.

CIRCUIT BREAKERS—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., recently issued an 8-page folder on its indoor, manually or electrically operated, 2, 3, and 4-pole, single throw, 400, 600 and 800 ampere, 15,000 volt oil circuit breakers. Application, distinctive features, mounting and construction are given together with tables containing data on the breakers and their accessories. Dimensional drawings also are included.

SPECTRUM ANALYSIS—Adam Hilger Ltd., London, Eng., has issued two booklets, one devoted to spectrographic outfits for metallurgical analyses and the other to the practice of spectrum analysis with the company's instruments. The instruments are described and illustrated and methods of use suggested.

COMPRESSORS—Ingersoll-Rand Co., 11 Broadway, New York, has issued a folder on its new line of air compressors. Illustrations point out the advantages and features of the machines and phantom views show the design and construction. An accompanying table gives the specifications of the machines.